GAS JOURNAL

LIGHT . HEAT . POWER . BYE-PRODUCTS

[Founded in 1849 as the "Journal of Gas Lighting."]

Vol. 204. 85th Year. LONDON, NOVEMBER 1, 1933. No. 3676. Price 1s.

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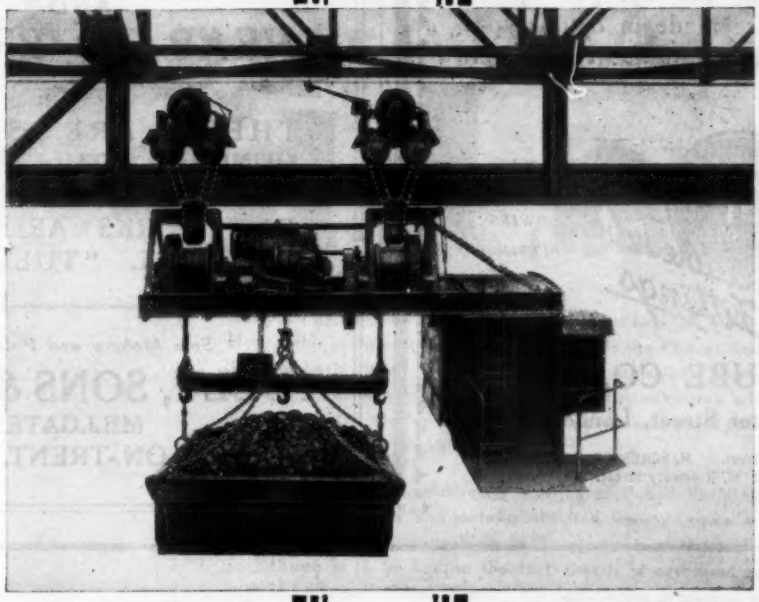

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The Meter that may be used :—

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The consumer has a FREE CHOICE of using either pennies or shillings. No alteration to meter mechanism is involved. Either coin can be inserted at will and the appropriate volume of gas delivered.

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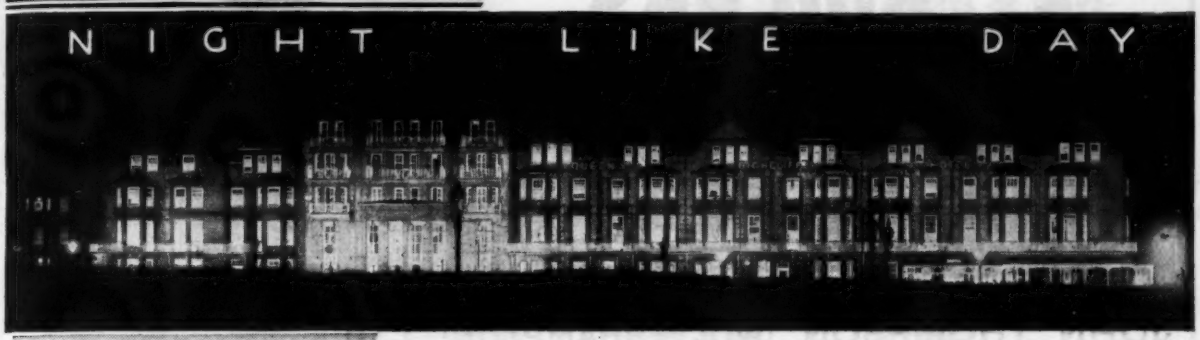
WE UNDERTAKE TO MANUFACTURE SILICA BLOCKS TO ANY SPECIFICATION REQUIRED.

COKE OVEN BLOCKS.

The Queen's Highcliffe Hotel, Cliftonville, Margate, floodlighted by this lamp.



Sugg's GAS Flood Lamp

Designed by the Technical Section of the Gas Light & Coke Co., Watson House, this lamp was first used to illuminate the Flower Beds, etc., of St. James's Park during the International Illumination Congress of 1931. Its wonderful efficiency prompted numerous enquiries, with the result that it is now in use for a variety of purposes throughout this country and also in many parts of the Continent.

For the more effective exterior lighting of Public Buildings, Churches, Memorials, Cinemas and suitably situated business premises, this Flood Lamp is a unique proposition, while evidence of the wide range of its application is to be had in the fact that it is now used extensively in L.M.S. Loco and Goods Sheds - the light being projected downward in this case, of course.

The lamp is fitted with a superheated cluster of ten No. 2 mantles, which remain stationary and independent of the movement of the powerful reflector, which is usually Chromium plated but is sometimes of silvered glass.

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The lamp in use at the War Memorial Gardens, Margate.

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NEW "Thompson"

BOILERS

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MOST MODERN "DISH-END" TYPE
WITH CORRUGATED SECTIONS
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"ECONOMIC"
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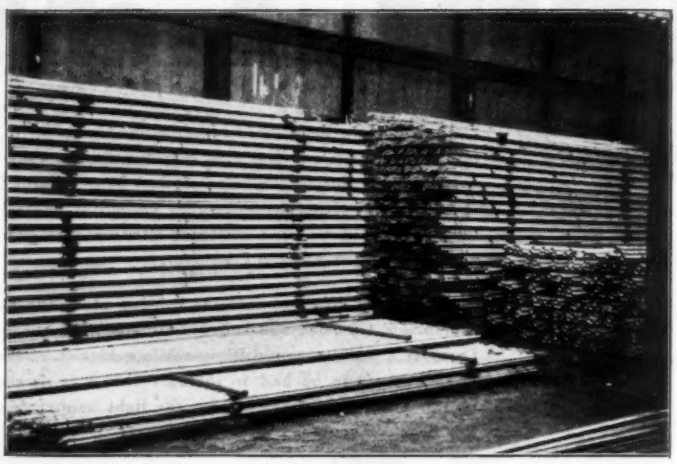

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TRADE MARK.

Fig. 705. "SINGLE RAM" STEAM-PUMP.

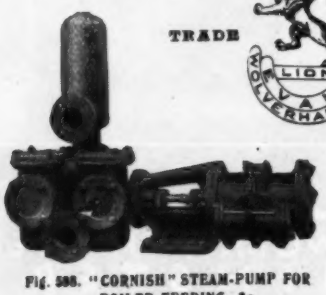

Fig. 588. "CORNISH" STEAM-PUMP FOR BOILER FEEDING, &c.

Fig. 685. "RELIABLE" STEAM PUMP FOR TAR AND THICK FLUIDS.

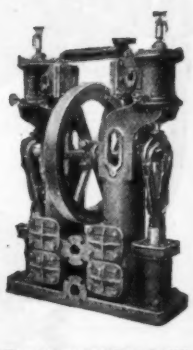

Fig. 712. "DOUBLE-RAM" STEAM-PUMP.

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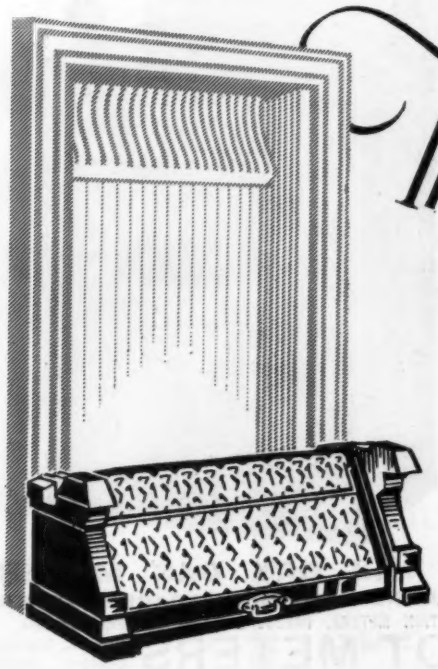
Supplementing the great scheme of national advertising for "C.C." Fires, which is now in full swing, comes yet another important advance and powerful sales-help.

A HEAT-RESISTING, STEEL GRATE BOTTOM, which will stand up indefinitely to a coke-fire, and which is being specially made by HADFIELDS of SHEFFIELD, is being fitted to all "C.C." models.

In addition to the certainty of efficiency and long service this gives to the purchaser of a "C.C." Fire, it also simplifies your selling, because you can now safely give a

3 YEARS' GUARANTEE

to "C.C." customers buying on Hire Purchase Terms.



The **C·C·FIRE**

PATENT NOS. 278115, 314721, 336824, 336825

Sales are steadily climbing. If you are not already displaying and demonstrating the "C.C." Fire in your Showrooms, arrange to do so now in good time for the peak season.

All models are made to burn coke and are gas-ignited.

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Sole Licencees for Manufacture and Sale.

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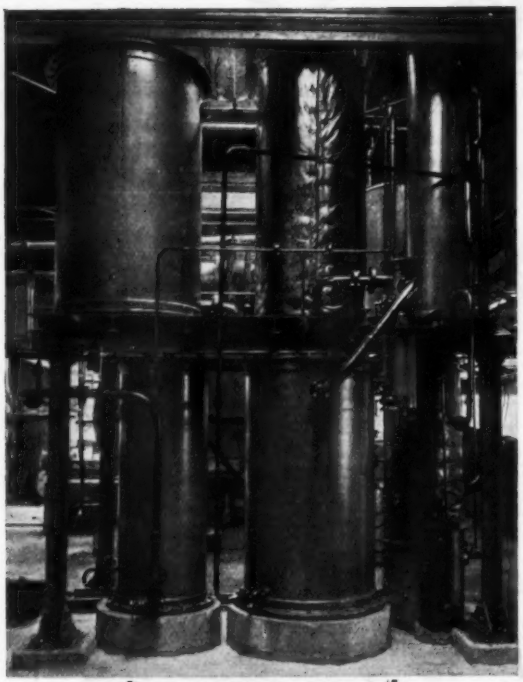
for

Large and Small Gas Works.



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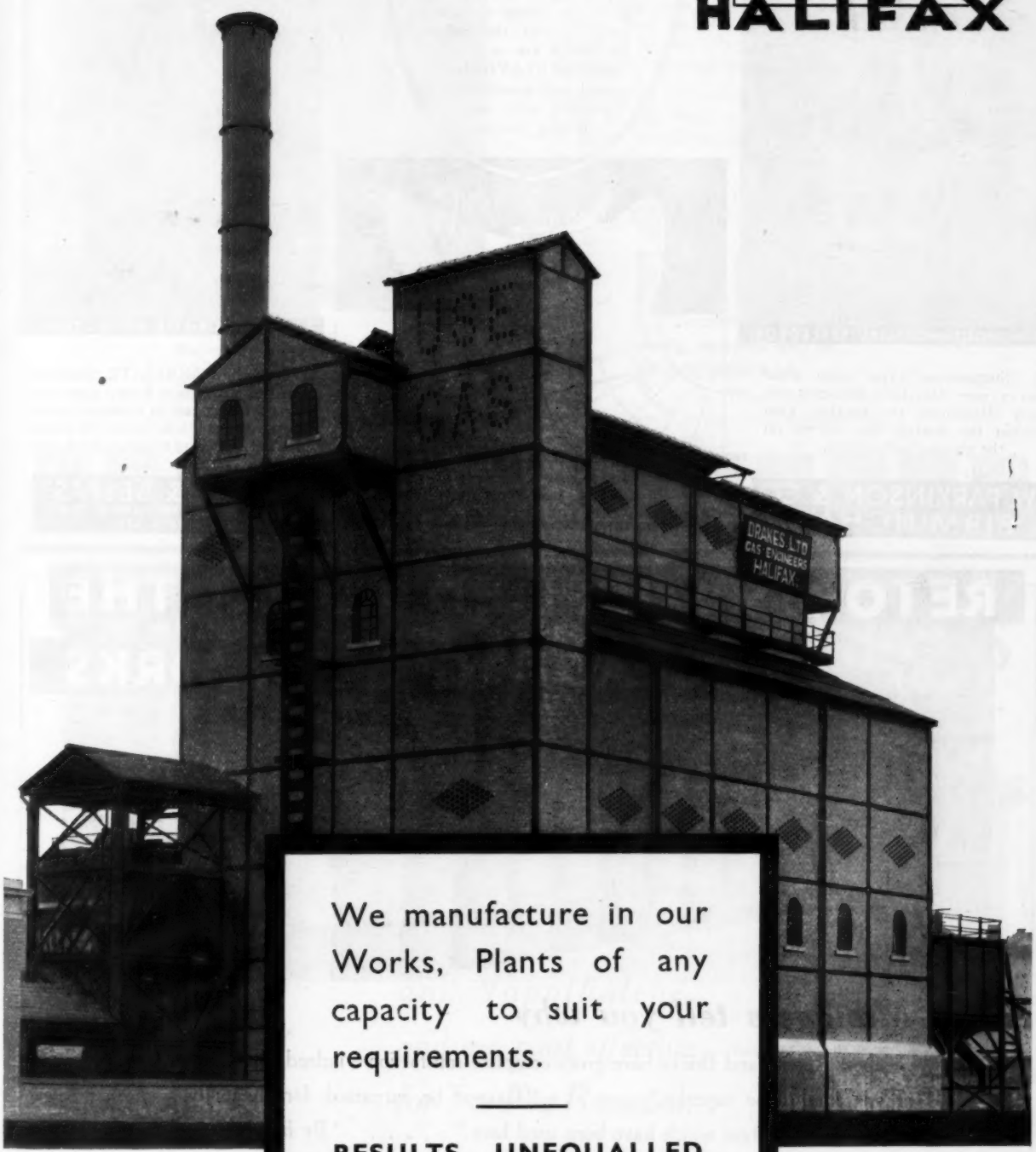

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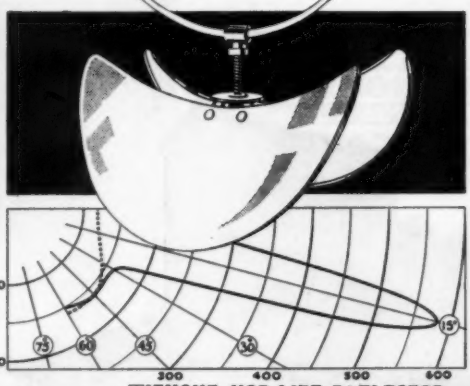
You can increase the illumination of suspension Lamps by 200 per cent. without extra cost by fitting the new MOR-LITE REFLECTOR. The Harp fitting is almost invisible, and the reflector wings are of highly polished STAYBRITE steel with simple adjustable clip and locking device.



.....WITHOUT MOR-LITE REFLECTOR
————WITH MOR-LITE REFLECTOR.

GRAPH SHOWING POLAR CURVE COMPARISONS FOR TWO LIGHT LAMP

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With a new MOR-LITE Reflector fitted a Suspension Lamp gives 200 per cent. increase in illumination as shown by the black line on the graph chart of Test, and without extra cost.

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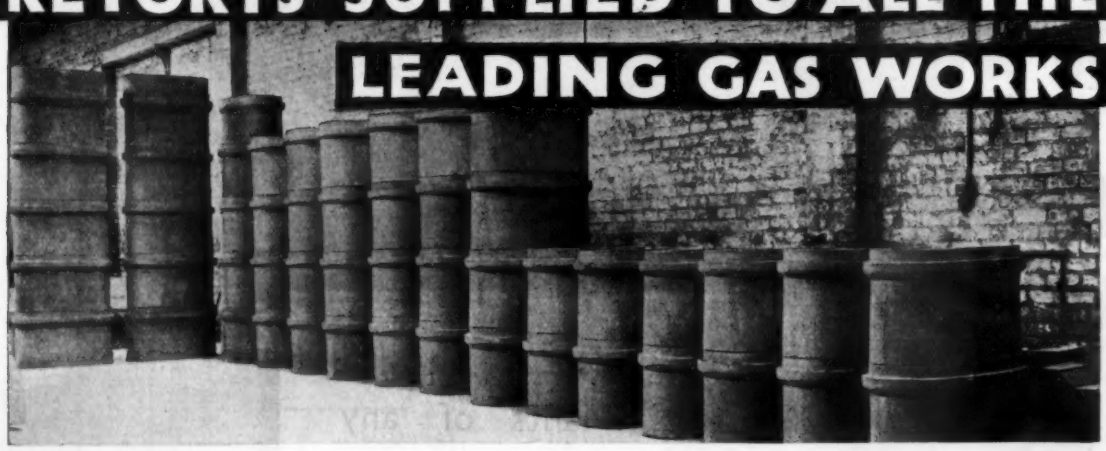

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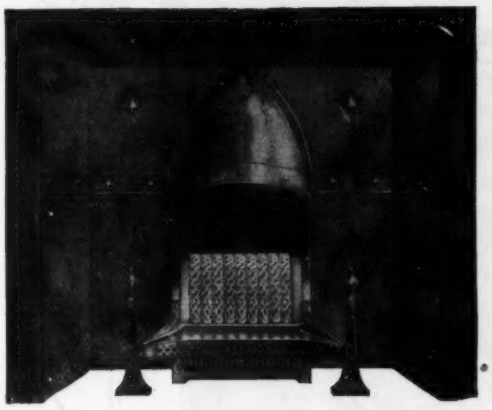
Modernising the Old-fashioned Coal Grate



Recessed Canopy Surround, "Crusader" pattern. Supplied in Oxidised Copper, Antique Brass, or any Art-Metal Finish.

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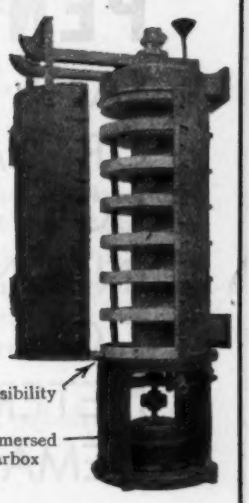

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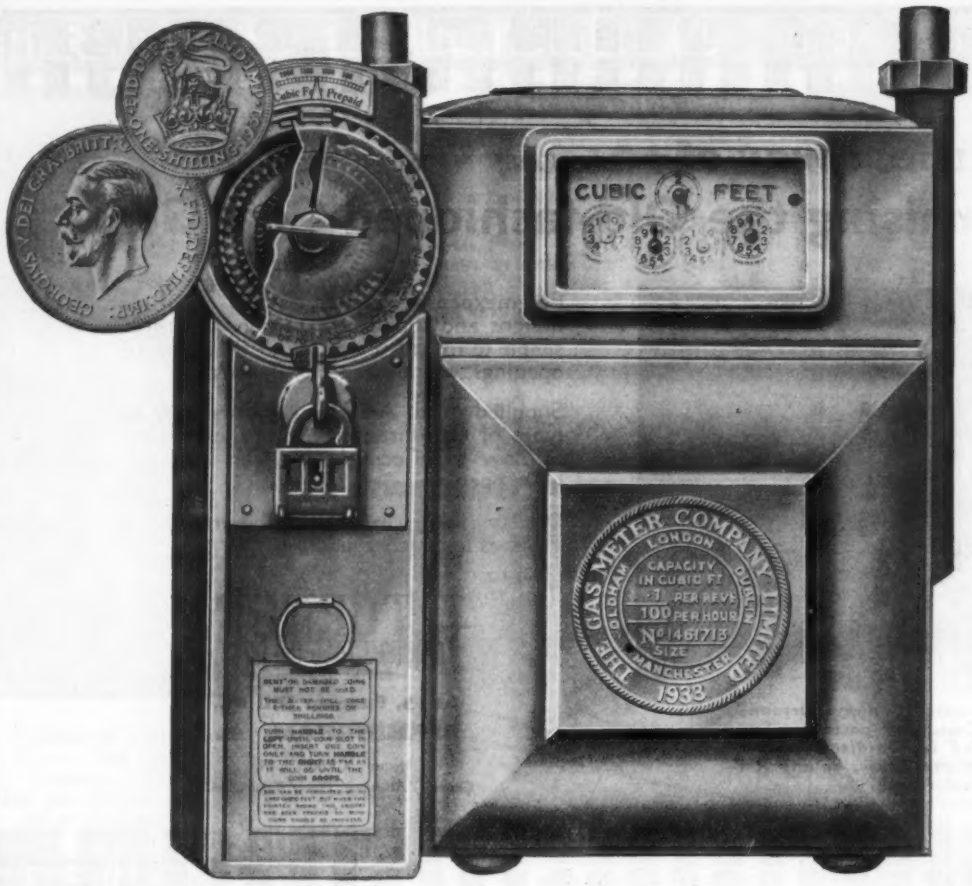

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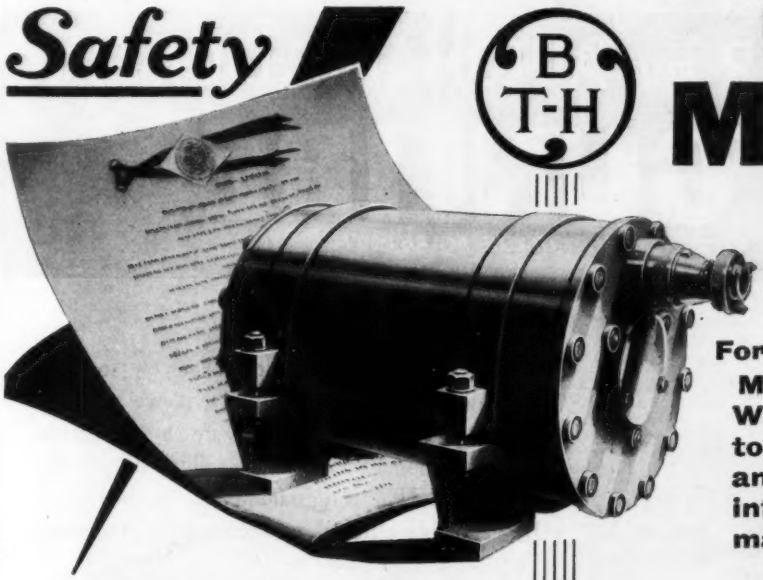

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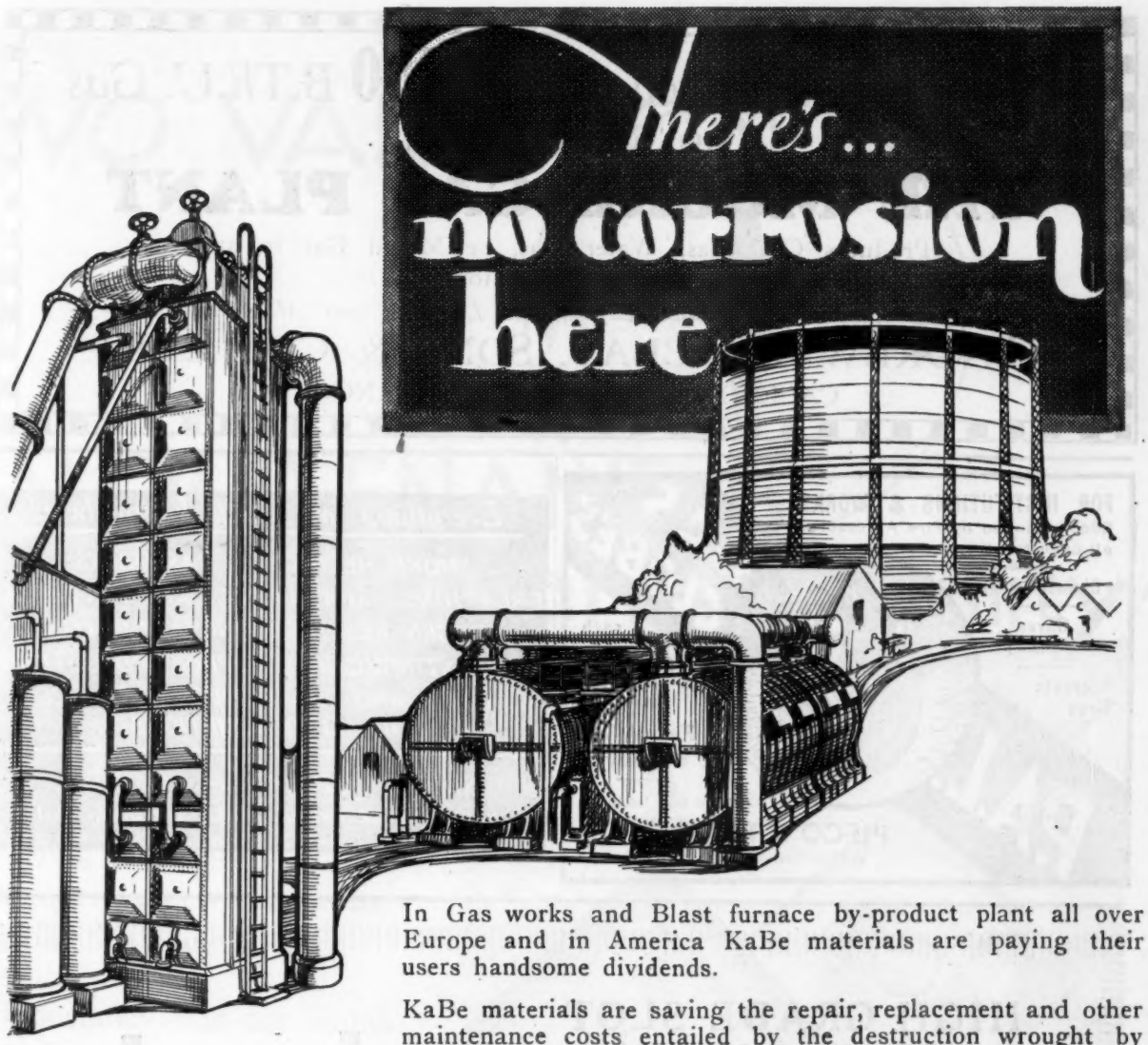

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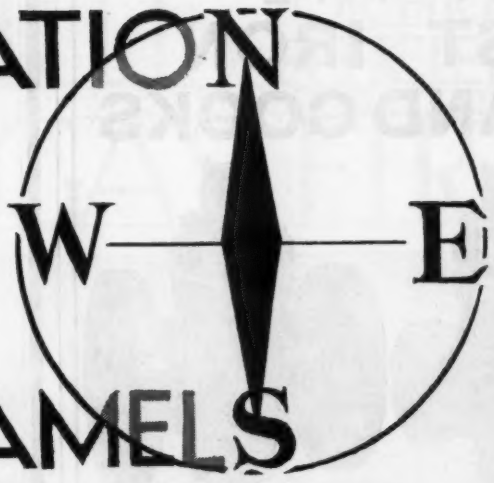

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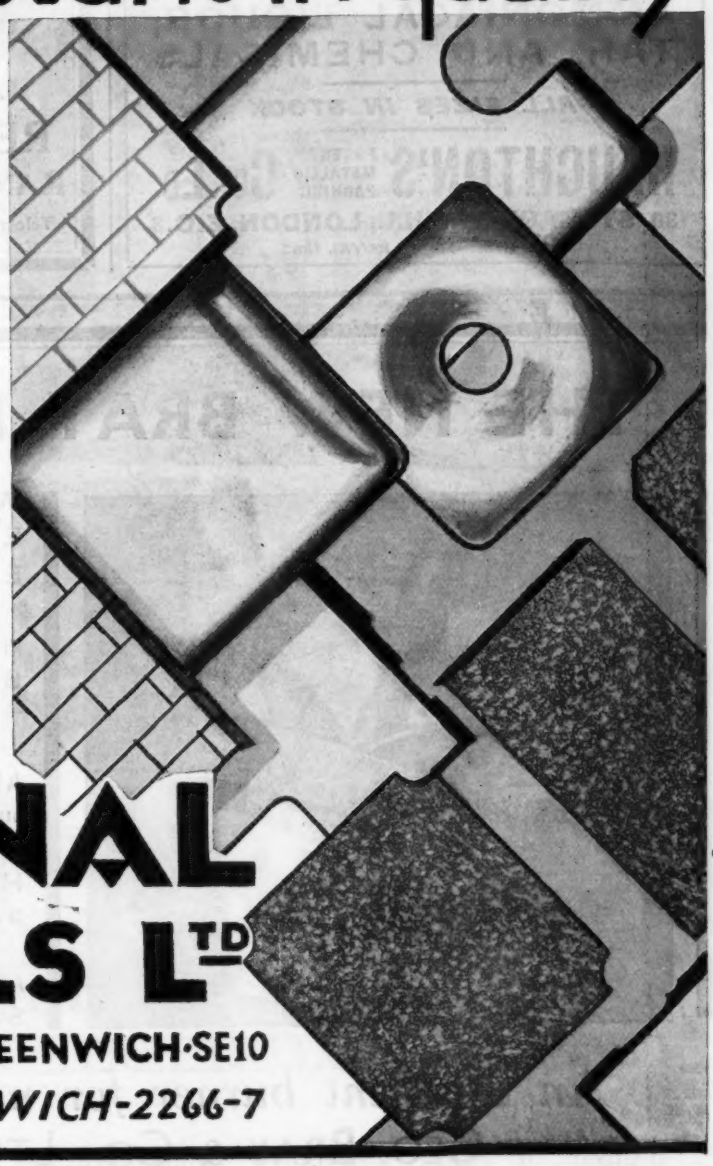

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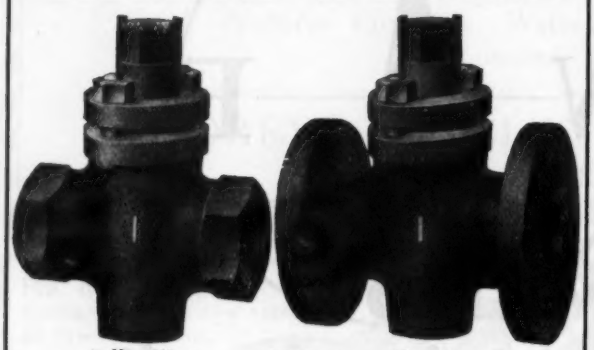

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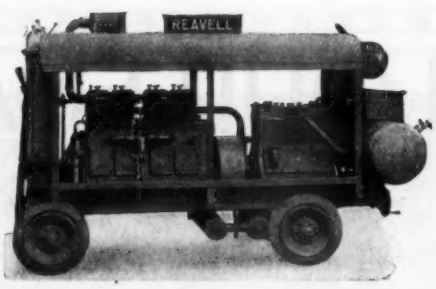

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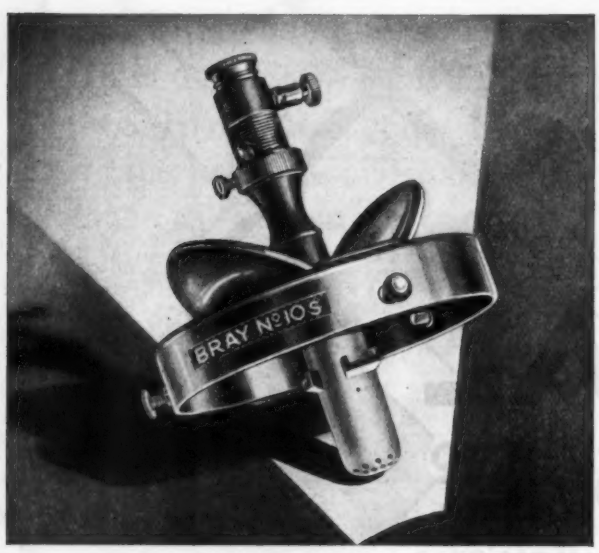

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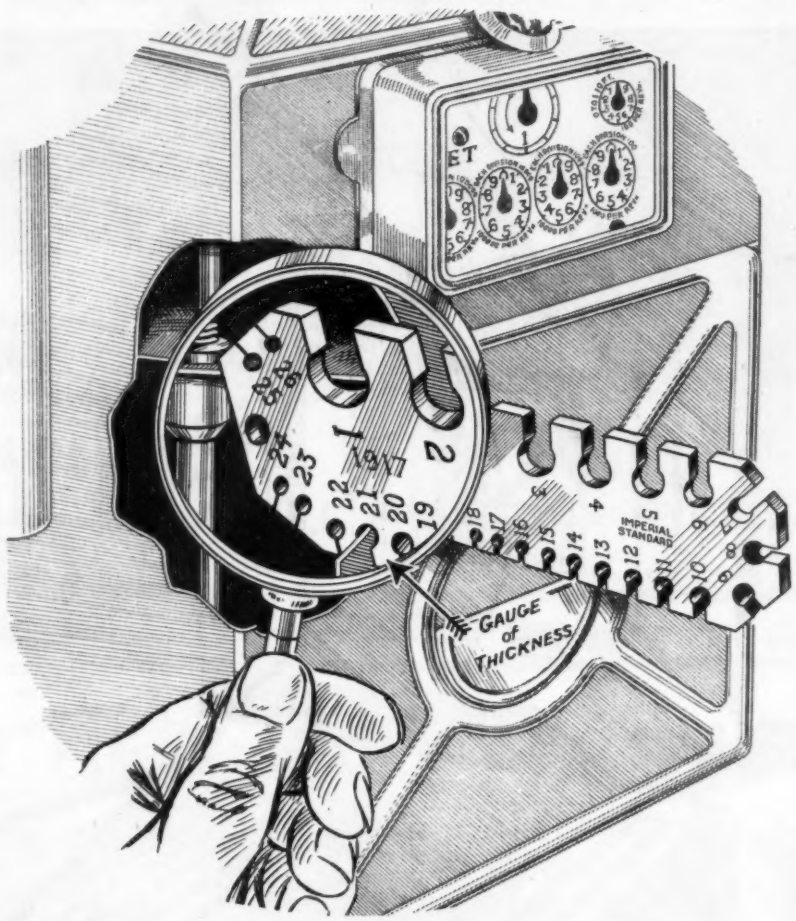

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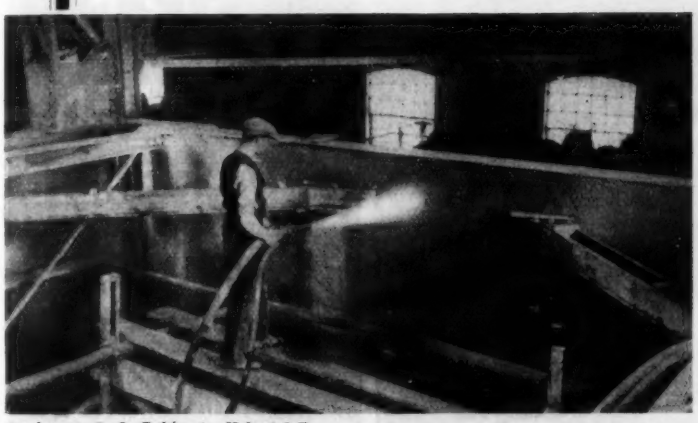

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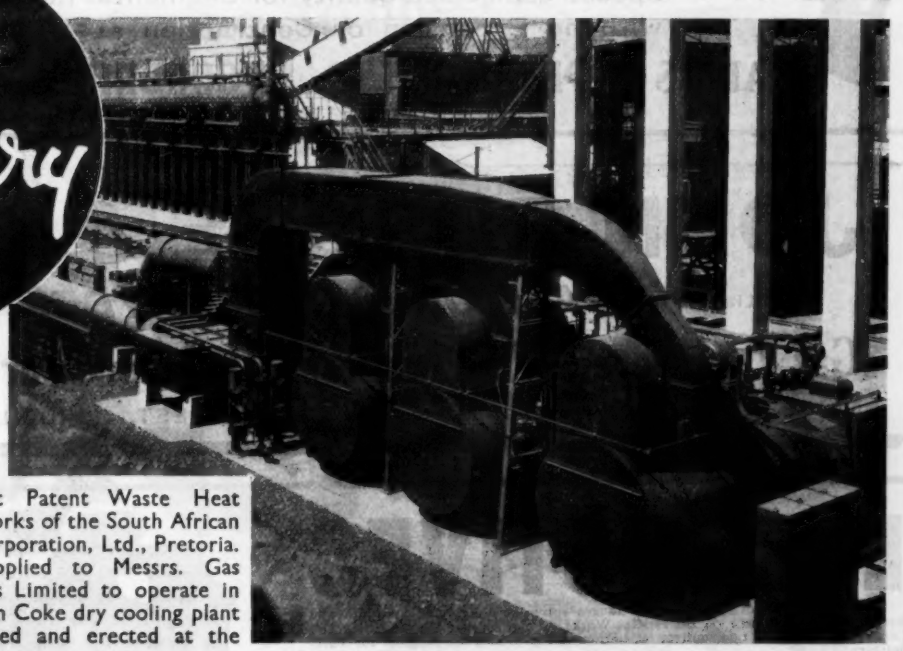

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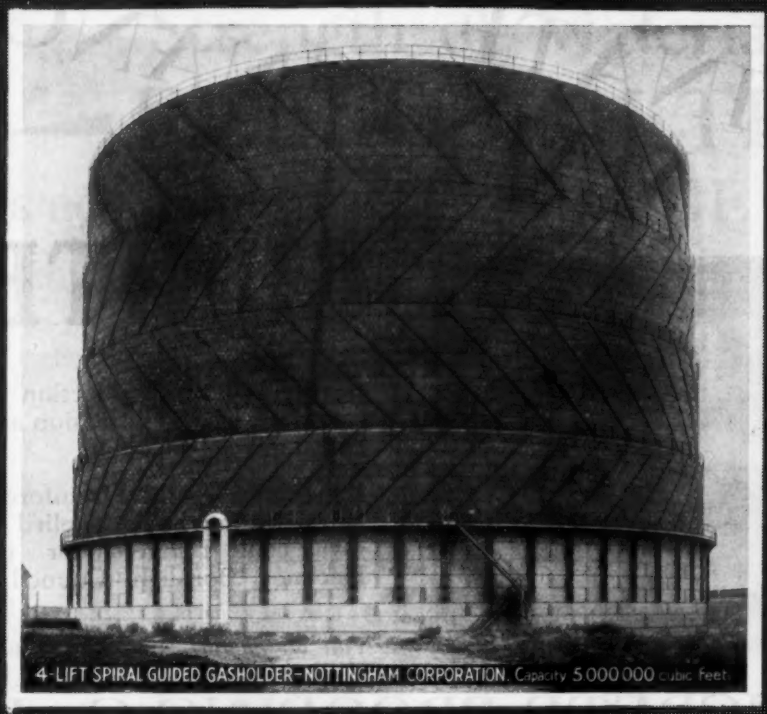

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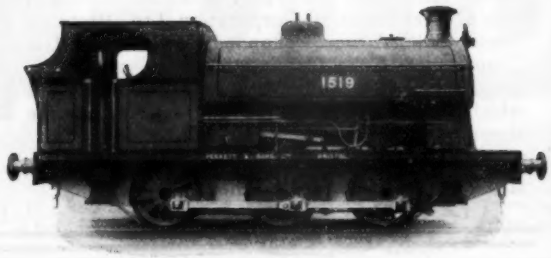

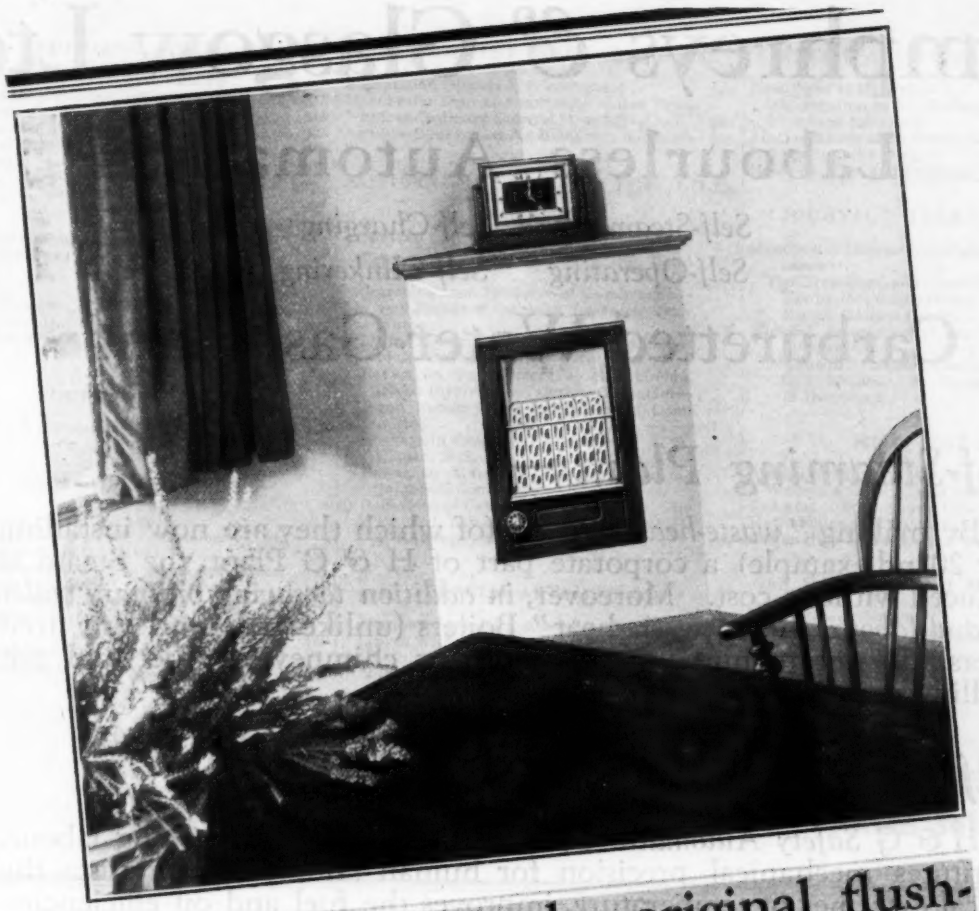

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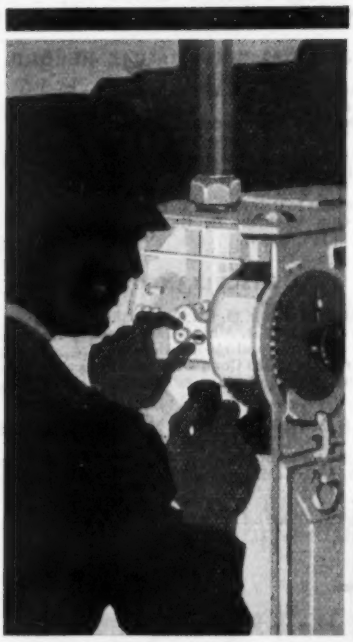

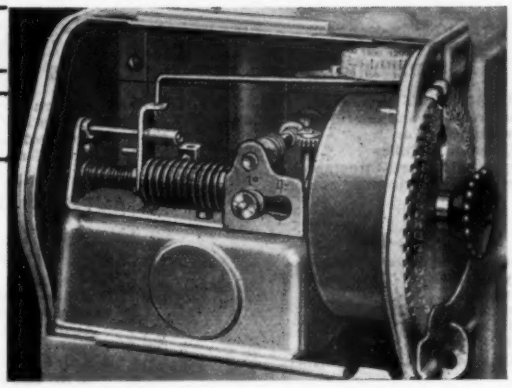

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THE GAS JOURNAL

NOVEMBER 1, 1933

Vol. 204. 85th Year No. 3676

A Glance at the Contents—

Darwen's New Carbonizing Plant.

New vertical retorts by Messrs. Drakes, Ltd., together with ancillary plant, were formally inaugurated by Sir Herbert Samuel at Darwen on Oct. 25. [p. 327.]

Tar Treatment at Gas-Works.

Mr. A. L. Holton claims that great economies can be effected by utilizing the sensible heat of hot crude gases for the treatment and partial distillation of tar. He deals with the Cooke and the Cooke-Holton processes at the works of the Manchester Gas Department. [p. 331.]

Steaming in Horizontals.

In our Correspondence Columns to-day Mr. H. D. Madden says that, if any engineer introduces steaming of horizontal charges, it would be to the Gas Industry's advantage if he would advise Dr. F. S. Sinnatt, Director of Fuel Research, of the results obtained, as Mr. Madden has arranged to do from Cardiff, where steaming will be carried out during the carbonization of coals from the South Wales Coalfield. Such interchange of information would undoubtedly be most helpful and would expedite research. [p. 320.]

Radiation Research Kitchen.

On Wednesday last, at the invitation of Radiation Limited, a number of Press representatives inspected the firm's new Research Kitchen and witnessed some interesting practical demonstrations. [p. 323.]

Research Reports.

We publish as a Supplement to the "JOURNAL" to-day our abstracts of the Reports and Communications to be presented at the Autumn Research Meeting of the Institution of Gas Engineers, which is to be held at the Institution of Mechanical Engineers on Tuesday and Wednesday next, Nov. 7 and 8.

Repair of Concrete Structures.

"A Working Guide to the Repair of Concrete Structures" would be an apt title to the valuable practical paper given by Mr. G. C. Pearson to the Midland Association last week. The paper is packed with information which will be helpful to all who have in their charge reinforced concrete structures or who contemplate their erection. [p. 343.]

Forthcoming Engagements

Nov. 2.—MIDLAND JUNIOR ASSOCIATION.—Paper by Mr. F. L. Atkin on "The Design of Town Gas Fired Furnaces."

Nov. 3.—GAS COMPANIES' PROTECTION ASSOCIATION.—Meeting of Committee at 5, Victoria Street, S.W. 1.

Nov. 4.—SCOTTISH JUNIOR ASSOCIATION.—Joint Visit to Edinburgh. Paper by Messrs. Humphreys & Glasgow, Ltd. on "Automatic C.W.G. Plant."

Nov. 6.—I.G.E.—Meetings of Finance Sub-Com.nittee, 2 p.m.; Membership Sub-Committee, 2 p.m.; General Purposes Committee, 3 p.m.; Council, 4.15 p.m., 28, Grosvenor Gardens, S.W. 1.

Nov. 7-8.—I.G.E.—Autumn Research Meeting, Institution of Mechanical Engineers.

Nov. 9.—S.B.G.I.—Meeting of Council at 11 a.m.

Nov. 9.—S.B.G.I.—Autumn General Meeting, Hotel Metropole, London.

Nov. 11.—MANCHESTER AND DISTRICT JUNIOR ASSOCIATION.—Visit to Oldham. Paper by Mr. H. Partington.

Nov. 14.—I.G.E.—Session at the Public Works, Roads, and Transport Congress and Exhibition, Royal Agricultural Hall, 11 a.m.; Joint Session of the Institution and the Association of Public Lighting Engineers, 3 p.m.

Nov. 14.—I.G.E.—Meeting of Gas Education Committee, 5 p.m., 28, Grosvenor Gardens, S.W. 1.

Nov. 15.—SOUTHERN ASSOCIATION.—General Meeting, Hotel Metropole, London, at 2.15 p.m.

Nov. 22.—B.C.G.A.—Meetings of the Executive Committee, 12 noon; General Committee, 2.30 p.m., 28, Grosvenor Gardens, S.W. 1.

Nov. 25.—NORTH OF ENGLAND AUXILIARY ASSOCIATION.—Half-yearly Meeting at Newcastle. Paper by Dr. G. P. Lishman, F.I.C.

Nov. 25.—WESTERN JUNIOR ASSOCIATION.—Meeting at Bath. Inspection of Messrs. Stothert & Pitt's Pump Department. Paper by Mr. G. K. Rose.

Nov. 29.—I.G.E.—Meeting of Meters Committee, 2.30 p.m., 28, Grosvenor Gardens, S.W. 1.

Dec. 1.—WESTERN JUNIOR ASSOCIATION.—Meeting at Bath. Address by Mr. F. P. Tarratt.

Dec. 2.—SCOTTISH EASTERN JUNIOR ASSOCIATION.—Visit to R. & A. Main, Ltd., Falkirk. Paper or Cinema Display.

Dec. 6.—MANCHESTER AND DISTRICT JUNIOR ASSOCIATION.—Visit to Thomas Glover & Co., Ltd., Manchester. Lecture on the "Manufacture of Meters."

Dec. 7.—MIDLAND JUNIOR ASSOCIATION.—Meeting. Paper by Mr. G. H. Davies.

Dec. 8.—LONDON AND SOUTHERN JUNIOR ASSOCIATION.—Meeting. Paper by Mr. H. J. Risby.

Dec. 9.—SCOTTISH WESTERN JUNIOR ASSOCIATION.—Meeting. Paper by Mr. A. Bujnowski.

Dec. 11.—I.G.E.—Meetings of Finance Sub-Committee, 2 p.m.; Membership Sub-Committee, 2 p.m.; General Purposes Committee, 3 p.m.; Benevolent Fund Committee of Management, 4.30 p.m., 28, Grosvenor Gardens, S.W. 1.

Dec. 12.—I.G.E.—Meetings of Council, 10 a.m.; Gas Education Executive Committee, 4 p.m., 28, Grosvenor Gardens, S.W. 1.

Dec. 21.—I.G.E.—Meeting of Refractory Materials Joint Sub-Committee, 2.30 p.m., 28, Grosvenor Gardens, S.W. 1.

1933 "JOURNAL" Directory.

Page 36. ILFRACOMBE. R. S. Falkner appointed E. and M. vice J. Armstrong.

Page 74. WESTON-SUPER-MARE. J. F. Marlow appointed S., vice T. W. Luckhurst, resigned.

EDITORIAL NOTES

The President and the Institution Tour.

SIR,—In view of the fact that many of my colleagues at home and overseas will be reading your excellent reports of the recent visit of the Institution of Gas Engineers to Canada and the United States of America, I should like to record the great indebtedness of those who participated in the visit, to the Canadian Gas Association, the American Gas Association, and our many hosts and hostesses, for the facilities and privileges we were accorded, and the kindness and hospitality we received.

We were greatly interested in the proceedings at the Canadian Gas Convention and at the American Gas Convention, while we were much impressed with what we saw at the numerous Gas Undertakings we visited. Many lasting friendships were made, and I am confident that even closer relationship will ensue, to our mutual advantage, between the Canadian, American, and British Gas Industries.

FRANK P. TARRATT,
President, The Institution of Gas Engineers.

Oct. 30, 1933.

Treatment of Tar

AN increase of a penny a gallon in the selling price of tar is equivalent to just under a penny per 1000 c.ft. of gas. In a paper before the Manchester District Association Mr. A. L. Holton states that economies can be effected by utilizing the sensible heat of hot crude gases for the treatment and partial distillation of tar; and his contribution, which is published *in extenso* in to-day's "JOURNAL," may, we think, have a marked bearing on gas-works practice. The author deals with the working of the Cooke and the Cooke-Holton processes at the works of the Manchester Gas Department. The latter process has been applied in connection with the Trefois producers at the Bradford Road Works. The original lay-out of the plant was modified by the addition of a vertical main up which the hot producer gas passes in counter-current to tar which is sprayed in at the top. The distillate passes forward with the gas stream, which passes through a tubular condenser. The lighter oils remain in the gas, increasing its calorific value by 40-50 B.Th.U. per c.ft., while the heavier oils are condensed. Circulation of the tar is so adjusted that the final product complies with all specifications for road tar. Mr. Holton explains that no difficulty has been experienced during the time the plant has been in operation—a matter of eighteen months. Very little labour is required, the operation being one mainly of pump control, which is performed by the Trefois plant attendant, so that no extra cost is incurred except for mixing and loading.

In regard to the application of the Cooke process of tar distillation by the hot crude coal gas in the foul main, the initial experiments were made at the Rochdale Road Works, where the entire gas production is from an early type of Glover-West setting. Details of the work are given in the paper; it is sufficient here to say that the plant ran satisfactorily for twelve months before being dismantled for the reconstruction of the retort bench, and that such success attended the enterprise as to warrant the experiment being continued in greater detail at the Partington Works. Here a bed of eight vertical retorts of the standard Glover-West type was fitted for the treatment of tar by the Cooke process. The plant treats 600 gallons of tar every eight hours, and road tars complying with Nos. 1 and 2 British Standard Specifications are produced. The process has been further developed to include Hird stills, heated by producer gas, for the manufacture of pitch. On the Trefois plant at the Bradford Road Works and on the Glover-West plant at the Partington Works there has not been the slightest difficulty in producing No. 3 road tar or even soft pitch by the Cooke process. "It has been commonly considered," states Mr. Holton, "that vertical retort tar was unsuitable for the production of road tar, but no difficulty has been experienced in producing road tars from either Rochdale Road Works or Partington Works tars which meet, in all particulars, the British Standard Specifications."

A Question of Policy

WHAT does the process mean to the Gas Industry? The author's answer to this question constitutes an important section of his paper. Whether gas-works decide to distil completely to the primary products or confine themselves to the preparation of road tar, the process described, it is stated, can fill the bill; but he emphasizes that, whichever course is adopted, *it is vital that the products should conform strictly to standard specifications.* This is easily attained by the larger works; but the smaller works have not the necessary trained staff at disposal, and the author points to the advantages which would accrue if they combined to make available the services of a trained technician who could direct and supervise the process by regular and frequent visits. In any event, the dominant argument is that in every gas-works exist potentialities to increase the revenue from tar. Mr. Holton summarizes the advantages claimed for the process. There is the elimination of carriage costs on the crude tar from the gas-works to the tar distiller's works, and, in many cases, a reduction in the cost of carriage of the road tar to the purchaser. Then there is a reduction in labour costs, since the process is incorporated in gas-making operations. A reduction in fuel cost is also effected. With producer gas practice, less water is needed for condensing purposes; and the same applies to water gas manufacture. Finally, there is a saving in capital charges, since a portion of the plant is installed at every gas-works. "It may fairly be claimed," states Mr. Holton, "that on a conservative basis working costs will be reduced by approximately 5s. per ton of crude tar treated to the usual primary pro-

ducts, and for the production of road tar a much higher figure—probably 10s. per ton—since there would only be the cost of the storage tanks and pumping charges."

The question of marketing the products is discussed by Mr. Holton. The usual course adopted by gas undertakings is to sell crude tar under contract—co-operative or otherwise—for a defined period. If the process were put into operation, road tar and primary products would be available for disposal instead of crude tar. These might be sold direct or through an agent, or participation might be had in co-operative schemes in existence. Alternatively, a co-operative scheme might be found within the Industry. As for the small country works, who would doubtless confine the process to the production of road tar, their geographical position, instead of being a handicap, would be an asset. In the larger undertakings, the author suggests that it would probably be an advantage to be able to distil to the primary products; or, of course, the road tar, together with the recovered oils, might be sent to the tar distillers for subsequent treatment. Whatever the plan adopted, we would emphasize that the products sold must conform to the required specifications. The use of tar for road building and surfacing has developed because of the efforts to ensure that at all times the tar will meet requirements, in which respect the British Road Tar Association have done—and are doing—such splendid service.

Mr. Holton's claims by no means passed without criticism during the course of the keen discussion which followed the presentation of his paper; and the remarks of Col. Carr are of much importance. Col. Carr asks that, before any such revolutionary process (Mr. Holton, by the way, suggests that " revolutionary " is not an appropriate designation) is adopted, every cost figure should be scrutinized, and that a change of policy in regard to the marketing of tar is not to be undertaken lightly. At present the tar distillers are meeting the requirements of the road surveyor. They have their plant in economical large-scale units, adequate technical supervision, trained salesmen—in brief, a specialized personnel. And Col. Carr very much doubts whether the same high standard of uniformity of products would in practice be obtained if each undertaking decided to become sellers-direct or even if there were a co-operative scheme within the Industry. The tar market, he points out, is largely international. Its success therefore largely depends on efficient organization for export of products of distillation; and the tar distillers have borne this in mind in placing certain of their works on or near the seaboard. The home consumption, too, is provided for at suitably located centres. As to the plan of gas-works selling through agents, Col. Carr regards this as retrograde.

To have aroused such an excellent discussion is evidence of the interest of Mr. Holton's paper to our readers.

Repair of Concrete Structures

" A Working Guide to the Repair of Concrete Structures " would be an apt title to the valuable practical paper given by Mr. G. C. Pearson to the Midland Association last week. The paper is packed with information which will be helpful to all who have in their charge reinforced concrete structures or who contemplate their erection. The contribution is lucid, and its study will mean the avoidance of many pitfalls in concrete construction and saving in expenditure on repair work. The author makes it quite clear that he has ample faith in the efficiency of concrete in gas-works for certain structures, though the early experience of the Birmingham Gas Department was unfortunate. His account of this experience will be of the utmost service to those who are responsible for the maintenance of concrete structures erected either prior to or during the war.

The reconstruction of the Windsor Street Works at Birmingham, commenced just prior to the war, was undertaken during a difficult period. Owing to the difficulty in obtaining steel, ferro-concrete had to be adopted extensively; and the author explains that not only was ferro-concrete construction then largely in its infancy in this country, but difficulty was experienced in obtaining suitable materials. Again, the labour necessarily employed was unused to the type of work required. The concrete construction at the works included sub-structures for purifiers and vertical retorts, coke crane gantries, and coal hoppers, and in many cases deterioration of these buildings had set in. The principal causes which bring about such deterioration are insufficient cover of concrete over the steel, bad mixing of the ingredients, insufficient tamping, careless placing of the steel reinforcement, and excessive use of water in the concrete. Mr. Pearson points out that any attempt to repair deterioration brought about from such causes by means of a trowel or float, with cement and sand mixture, is quite unsatisfactory. It is not practicable to clear the surface of the old concrete completely of sand and dust and to trowel home the new concrete without air spaces between the old structure and the repair. Such repairs appear to do more harm than good, as they often camouflage the extended deterioration that is taking place.

A few years ago the author was faced with the fact that several of the ferro-concrete structures at the Windsor Street Works were badly deteriorated—so badly that, without efficient repair, it would have been necessary to condemn them as unsafe. Trowelling had been carried out from time to time, but to no good purpose. However, a remedy to this state of affairs was forthcoming; and this remedy—" Gunite " applied by the cement gun process—is the theme of Mr. Pearson's paper. A great many tests of the system have been carried out in the Birmingham Gas Department Industrial Research Laboratories, proving beyond doubt its efficacy. By careful selection of sand, it has been possible to bring the compressive strength of " Gunite " to the remarkable figure of 10,000 lbs. per sq. in., so that the building-up of a wasted member by this material effectively positioned actually increases the original strength of the member.

" Gunite " is not cheap; in some cases the cost of a repair may represent a sum about equal to the cost of the original member. On the other hand, probably few members of a building are in a really bad condition, and in the worst instances the necessary repair would be unlikely to extend beyond one-third of the structure. Further, the building can, with a few simple safety provisions, continue throughout the course of the repairs to perform the work for which it was designed. By the use of " Gunite " the Birmingham Gas Department has saved a considerable outlay on reconstruction. The system can be applied to a wide variety of work, such as chimney linings and hoppers, and is especially useful for the wearing surfaces of chutes, such as steel coke chutes. Again, it is most useful where it may be desired to extend an existing concrete structure. Mr. Pearson mentions that the points of junction of the old and new work can be coupled up in a highly satisfactory manner. Also it is excellent when employed to increase the loading for which a building was originally designed, involving the introduction of extra steel reinforcement. An alteration of this type has been carried out on the ferro-concrete superstructure supporting a row of vertical retorts at Windsor Street, and is described in detail in the paper.

Steaming in Horizontals

The extent to which dilution by coal gas can be carried out when making gas of a given declared calorific value depends upon the calorific value of the straight coal gas made. Discussing this question in his Presidential Address to the Midland Junior Gas Association—comment on which was made in our issue for Oct. 18 last—Mr. S. K. Hawthorn observes that the make of therms of the enriching hydrocarbons and the calorific value thereof is the true index to gas-making efficiency, and he maintains that in this direction lie possibilities of improvement. A high thermal yield of hydrocarbons in coal gas appears to depend upon correct heat treatment of the tarry vapours, it being necessary to maintain a balance between " over-cracking " and " under-cracking." This matter is the subject of a letter in to-day's " Journal " by Mr. H. D. Madden, who, while serving as a member

of the Fuel Research Board suggested that the steaming of a horizontal retort charge might profitably be re-examined, " to ascertain definitely if the nascent hydrocarbon vapours from the charge could be preserved from degradation through contact with the heated crown of the retort by the intervention of steam in the last few hours of the carbonizing period."

In the William Young Memorial Lecture, Dr. F. S. Sinnatt outlined the results of the Fuel Research Board's investigation on steaming in horizontal retorts. Employing normal horizontal retorts with 12 cwt. charges, it has been found possible to introduce steam over the last three hours without marked influence on combustion chamber temperature. The result of this has been to raise the yield of gas from 75 to 87 therms per ton. The experiments have shown that there is little to be gained by adopting special methods of charging, provided the retorts are fairly full of coal. Calling attention to the Lecture in the " JOURNAL " for Sept. 13, we said: The first results published on this fascinating possibility in connection with horizontal retorts certainly merit the attention of engineers. When working the setting on 12-hour charges with a throughput of 10 tons per day the therms per ton were 75·1. Keeping the daily throughput and fuel consumption constant, by steaming for the last 2, 3, and 4 hours, the therms per ton were 84·6, 86·9, and 86·8 respectively, while the calorific values were 520, 512, and 475 B.Th.U. per c.ft. The last test was beyond the heat capacity of the setting, resulting in a temperature fall. These figures indicate the significance of the work on horizontals.

In our Correspondence Columns to-day Mr. Madden says that, if any engineer introduces steaming of horizontal charges, it would be to the Gas Industry's advantage if he would advise Dr. Sinnatt of the results obtained, as Mr. Madden has arranged to do from Cardiff, where steaming will be carried out during the carbonization of coals from the South Wales Coalfield. Such interchange of information would undoubtedly be most helpful and would expedite research.

PERSONAL

The Directors of the Weston-super-Mare Gaslight Company have appointed Mr. J. F. MARLOW, Assistant Secretary, to the position of Secretary of the Company in succession to Mr. T. W. Luckhurst, whose resignation was announced in the " JOURNAL " last September. Mr. Marlow was selected out of 106 applicants.

* * *

Mr. R. S. FALKNER, Engineer and Secretary to the Sandown Gas and Coke Company, Ltd., has been appointed Engineer and Manager to the Ilfracombe Gas Company, in succession to Mr. J. Armstrong.

OBITUARY

E. A. HARMAN, M.Inst.C.E.

The death took place at his home in Hull on Oct. 17 of Mr. Edward Alfred Harman, at the age of 73. Mr. Harman was for eighteen years Engineer and Manager of the Huddersfield Corporation Gas Department, whose service he left in 1915. Prior to his appointment at Huddersfield, he was for seven years Engineer's Assistant and Chief Draughtsman at the Saltley Works of the Birmingham Gas Department and subsequently Resident Engineer and Superintendent at their Swan Village Works. Mr. Harman was also for some years Senior Assistant at the Works of the British Gas Light Company at Hull. He was elected a member of the Sanitary Institute in 1900, and he did a considerable amount of work in connection with the disposal of sewage, having carried out several experiments on the production of gas from sludge.

* * *

H. T. ARMITT.

The funeral took place at Hampstead Cemetery on Oct. 25, of Mr. Henry Thomas Armitt, M.Inst.C.E., M.Inst.Gas E., of 4, Menelik Road, West Hampstead, who died on Oct. 21 after a long illness at the age of 67. The late Mr. Armitt came from an old Northampton family, in which town he was articled to the Gas Engineering profession, and from where he went to Chili to join the Santiago Gas Company.

He served the firm in Santiago for about a quarter of a century, and since his return to London some fifteen years ago he had represented its interests in the United Kingdom until the time of his death. He was a well-known and popular figure in gas engineering circles, and in his early life took an active part in the Masonic Craft, in which he was a Mark Mason. He was a Past-Master of the Eleanor Cross Lodge No. 1764 of Northampton and was Master of the Huelen Lodge in Santiago in 1894. He was held in the highest esteem by all who knew him.

* * *

Mr. SAMUEL BUCKLEY, of Ashton-under-Lyne, who died last week at the age of 74 years, retired in 1927 from the position of Secretary to the Ashton Gas Company. He had been in the employ of the Company for 41 years and rose from junior clerk to Secretary. The funeral took place on Saturday, Oct. 28.

Correspondence

Steaming in Horizontals.

SIR,—The recent Presidential Address to the Midland Junior Gas Association, given by Mr. S. K. Hawthorn, of Birmingham, is an interesting and opportune one, and has drawn attention to the fact that there is a distinct difference between the gaseous therms available per ton of coal and the number actually produced under the best carbonizing conditions; evidently his object was to try to discover means whereby the gap could be closed and more gaseous therms obtained.

When recently serving as a member of the Fuel Research Board, I suggested that the steaming of the horizontal retort charge might profitably be re-examined, more particularly for the improvement of tars for higher oil content; in fact, to ascertain definitely if the nascent hydrocarbon vapours from the charge could be preserved from degradation through contact with the heated crown of the retort by the intervention of steam in the last few hours of the carbonizing period.

Actually work on these lines was carried out in the horizontal retort house at Cardiff during the war, to ascertain if nascent tar could be safeguarded to produce a greater oil content for Admiralty purposes.

In the William Young Memorial Lecture recently delivered by Dr. Sinnatt, the Director of Fuel Research, it was stated that when this suggestion was carried out at the Fuel Research Station, the results showed that the gaseous thermal output had increased by some 10 therms per ton of coal carbonized. This would appear to bear out Mr. Hawthorn's theory that the nascent state of the gases and tar offer a field of investigation in order to obtain a higher thermal yield.

As an immediate past Member of the Fuel Research Board, may I respectfully suggest that if any of my brother gas engineers introduces steaming in the horizontal charges, it would be to the Industry's advantage if he would advise Dr. Sinnatt of the results obtained, as we have arranged to do from Cardiff, where the steaming will be carried out during the carbonization of coals from South Wales Coalfield.

Such interchange of information will undoubtedly be beneficial and profitable, and assist to expedite research.

Yours, &c.,
H. D. MADDEN,
Engineer and Manager.

Cardiff Gas Light and Coke Company,
Bute Terrace, Cardiff,
Oct. 25, 1933.

Will " Gas Salesman " Subscribers please note that the next issue of the " SALESMAN " will be published on Saturday, Nov. 25, instead of the usual third Saturday in the month?

THE NEWS OF THE WEEK

Sanction to Borrow £55,000 has been received by the Birkenhead Gas Committee from the Ministry of Health for the erection of continuous vertical retorts at the gas-works.

The Opening Meeting of the Institution of Civil Engineers will be held on Nov. 7, when an address will be given by the President, Sir Henry Percy Maybury, G.B.E., K.C.M.G., C.B.

Reductions in the Price of Gas have been made by the Louth Gaslight Company. The revised prices are 7·31d. per therm for ordinary meters, 9·48d. for slot meters, and 6·88d. for power.

"The Gas Industry" was the subject of an interesting address to members of the Shipley Rotary Club recently, at their weekly luncheon, by Mr. J. Beaconsfield Balmforth, Engineer, Manager, and Secretary of the Bingley Gas Department.

Modern Gas Equipment in Industry was the subject of a lecture to the Coventry Engineering Society by Mr. W. Hind, Industrial Gas Engineer to the Coventry Gas Department. The lecture is printed in the Sept.-Oct. issue of the Society's Journal.

The Directors of Meters, Ltd., have declared the following on account of the dividends for the current year: On the preference stock at the rate of 5½% per annum; on the ordinary stock at the rate of 5% per annum. The dividend warrants will be posted on Nov. 14.

Institution of Chemical Engineers Examination.—Application forms and particulars of the Associate-Membership Examination for 1934, together with the Memorandum on "The Training of a Chemical Engineer," may be obtained from the Hon. Registrar, Institution of Chemical Engineers, Abbey House, Westminster, S.W. 1.

A Joint Meeting of the Manchester District Association of Gas Engineers and the North-Western Section of the Institute of Fuel will be held at the Engineers' Club, Albert Square, Manchester, on Wednesday, Nov. 29, at 6.30 p.m., when Dr. E. W. Smith will give an address on "Solid Smokeless Fuel."

Seeing South Africa.—On Tuesday, Oct. 24, Mr. Walter T. Dunn, M.I.Mech.E., formerly Secretary to the Institution of Gas Engineers, gave at Hastings an interesting lecture entitled "Seeing South Africa." It was illustrated by about one hundred excellently executed lantern slides kindly lent by the High Commissioner of the Union of South Africa.

Adding Insult to Injury was the description applied by a speaker at the October meeting of the Warrington Town Council to a recommendation of the Street Improvement Committee to convert the lighting of the road past the gas-works from gas to electricity. After a discussion on the relative merits of gas and electricity for street lighting purposes, the Committee's resolution was referred back.

Gas-Works Pensioners Entertained.

Long-Service Awards at Walsall.

Over forty pensioners of the Walsall Corporation Gas Department were entertained at tea at the Council House recently by the Mayor (Councillor William Dean), who is Chairman of the Gas Committee.

Fifteen of them received framed certificates for long service as follows: A. Webster, 52 years; T. Wilkinson, 44; G. Gibbs, 43; J. Bowler, 42; G. Parker, 41; A. Turck, 39; J. Evans, 36; W. M. Green, 36; W. Upton, 35; G. Robinson, 31; W. Webster, 30; T. Grundy, 23; J. Wollams, 21; T. Bentley, 16; and J. O'Neill, 16. The oldest pensioner is Mr. J. Simkiss, who is 82 years of age.

The Mayor, welcoming the guests, said he felt that when he held the position of the Mayor and Chairman of the Corporation Gas Committee he would like the old work-people to accept his hospitality. The gas undertaking was the only one belonging to the Corporation that had a pension scheme, and he hoped that before long such schemes would be generally adopted.

Councillor Fletcher (Vice-Chairman) commented on the number of "young old men" present, which went to show that gas-making was not unhealthy.

Alderman Leckie said that although the gas undertaking had passed through anxious times owing to trade depression, he believed there was a great future for gas, especially in industry.

The Gas Engineer (Mr. F. Davies) expressed thanks to the Mayor and Mayoress.

Lord Mayor of London Inspects Gas Cooker.

Our photograph shows the Lord Mayor of London, Sir Percy Greenaway, and Lady Greenaway, together with the Mayor of Bethnal Green, inspecting one of Wright's "Beau" finish "New World" gas cookers on the occasion of their recent visit to the Exhibition of Industries at York Hall, Bethnal Green.

Gas Leads to Success.

The Newcastle-upon-Tyne Co-Operative Society, Ltd., have just completed their second successful year with all-gas-fired ovens at their bakeries in Newcastle. During that period they have baked almost half-a-million stones of flour, yielding 5,200,000 loaves, also fancy cakes to the value of £40,000.

The total output of the Bakeries last year amounted to £106,631. They exhibited at the International Exhibition in London this year and were awarded gold and bronze medals for Wedding, Birthday, and Christmas cakes.

Midland Association of Gas Engineers and Managers.

Autumn Meeting in Birmingham.

The Autumn General Meeting of the Midland Association of Gas Engineers and Managers was held at the Grand Hotel, Birmingham, on Oct. 26—Mr. T. H. POULSON (Stafford), the President, in the chair.

The PRESIDENT welcomed the visitors, including Alderman J. H. Lloyd, Chairman of the Gas Committee of the Birmingham Corporation. Alderman Lloyd, he said, was a good friend of the Gas Industry and always accorded them his fullest support.

The following new members were elected: Wm. Macnaughton, Assistant Engineer, Wolverhampton; J. H. Rioch, Engineer and Manager, West Bromwich; S. G.

THE NEWS—*continued.*

Kemp, Manager, Quorn; James Mitchell, Engineer and Manager, Leicester.

The PRESIDENT welcomed the new members.

The PRESIDENT proposed Mr. Hubert Pooley (Leicester) and Mr. T. H. Hack (Birmingham) as Hon. Members.

Mr. C. H. CARDER, in seconding, said they had done good work for the Association.

The following certificates were presented to successful students in the Higher Grade Examinations in Gas Engineering and Gas Supply:

N. Bedingfield, Birmingham	1st,	Gas Engineering	(Internal)
J. A. Claydon, Birmingham	1st,	,,	,,
A. V. North, Dudley	1st,	,,	,,
N. C. W. Allin, West Bromwich	2nd,	,,	,,
A. St. D. Corder, Birmingham	2nd,	,,	,,
A. G. Cranmer, Wolverhampton	2nd,	,,	,,
R. N. Hateley, Walsall	2nd,	,,	,,
K. L. Pearce, Dudley	2nd,	,,	,,
E. C. Royall, Brierley Hill	2nd,	,,	,,
H. A. Ward, Birmingham	2nd,	,,	,,
S. C. Bentley, Leicester	1st,	,,	(External)
A. V. Wainwright, Shrewsbury	1st,	,,	,,
P. Grealy, Kidderminster	2nd,	,,	,,
J. S. Warrilow, Stoke-on-Trent	2nd,	,,	,,
J. C. Wimhurst, Newcastle, Staffs.	2nd,	,,	,,
N. Bedingfield, Birmingham	1st,	Supply	,,
S. Brockbank, Bridgnorth	1st,	,,	,,
D. I. Keir, Birmingham	1st,	,,	(Internal)
R. Kimble, Birmingham	1st,	,,	,,
W. J. Parsons, Birmingham	1st,	,,	,,
A. H. Tipton, Birmingham	1st,	,,	,,
G. A. Blackwell, Birmingham	2nd,	,,	,,
R. R. Crump, Birmingham	2nd,	,,	,,

The PRESIDENT congratulated them on their success and expressed the best wishes for the future.

Mr. W. S. MORLAND (Gloucester) proposed the election of Mr. R. S. Ramsden (Leamington) as President. He said he had been connected with the Association for a great many years and had always been a hard worker. They could not have a more suitable President.

Mr. A. H. CRANMER (Wolverhampton) seconded.

The resolution was heartily carried.

NEW OFFICERS.

President.—Mr. R. S. Ramsden (Leamington).

Vice-President.—Mr. Arthur Roberts (Hereford).

Committee.—Messrs. E. Hardiker (Smethwick), A. H. Cranmer (Wolverhampton), G. C. Pearson (Birmingham), and H. Banks (Northampton).

Auditors.—Messrs. J. Brettle (Lower Gornal) and Fred Davies (Walsall).

Hon. Secretary and Treasurer.—Mr. S. J. Sadler (Solihull).

REPAIRS TO REINFORCED CONCRETE—BY CEMENT GUN METHOD.

A paper bearing this title was presented by Mr. George C. Pearson, of the Birmingham Gas Department. This, and our report of the discussion, will be found on later pages of to-day's "JOURNAL."

Coleraine's Startling Discovery.

No Statutory Right to Sell Gas.

The Coleraine Borough Council, having decided to extend their gas supply to Portstewart, a seaside resort four miles distant, at an estimated cost of about £10,000, have made the startling discovery that they have not even statutory authority to sell gas in Coleraine.

This remarkable state of affairs was disclosed at a special meeting of the Council when the question of taking the gas to Portstewart was again under discussion. The gas supply in Coleraine has been a public undertaking for over 80 years. The Clerk (Mr. W. E. Henry) stated that the Council had authority to undertake the public lighting of the town, but there was no record of any statutory authority ever having been obtained to sell gas for private consumption. The Ministry, added the Clerk, had searched the British Isles for a parallel case but had been unable to find one.

The Mayor (Alderman D. H. Christie) said the Clerk and he had an interview with the Ministry of Commerce and the Ministry of Home Affairs with reference to the question, and they found that the position was that the Council had not even a right to sell gas in Coleraine. Apparently they had no statutory power to do so—or at least there was no trace of it. The first thing the Council would require to do would be to get power to sell the gas in Coleraine before they could take it to Portstewart.

Councillor A. J. Cunningham inquired if anyone could step in and interfere with their gas supply now, after 80 years, to which the Mayor replied that he did not suppose that would happen; but that was, nevertheless, the position as they understand it.

The Clerk said he had ascertained that in 1845 the then Town Commissioners, under the powers which they had under the Lighting and Watching of Towns Act, 1828, started the gas-works for the purpose of lighting the streets. They had power to light the streets, but it gradually evolved into supplying gas for private purposes, and there was no power to do that.

Further consideration of the matter was adjourned.

A Radiation Display at Birmingham.

The "Birmingham Dispatch" have a spacious entrance hall at their Birmingham Offices, which they kindly offered to Radiation Limited for an advertising display during the last two weeks. Our photograph shows the attractive display carried out, the design being in black velvet, aluminium, and emerald green. There is always a large number of people passing through this entrance hall, and there is no doubt that the display formed a very effective advertisement.

Manchester District Association of Gas Engineers.

An Ordinary General Meeting of the Manchester District Association of Gas Engineers was held at the Midland Hotel, Manchester, on Friday, Oct. 27, the President, Mr. G. Dixon, B.Eng., Assoc.M.Inst.C.E., being in the chair.

A luncheon was held prior to the meeting; and it is proposed that this "Association Luncheon" shall be an annual event. Among the letters regretting absence was one from Mr. F. P. Tarratt, President of the Institution of Gas Engineers.

Certificates gained in the recent Examinations of the Institution of Gas Engineers were presented to the following successful students:

Higher Grade Gas Engineering (External Candidates).

F. S. Charnley	Liverpool	2nd Class
C. James	Salford	,,
F. H. Jolly	Wrea Green	,,
R. Mason	Kendal	,,
V. J. J. Siddons	Barnsley	,,
J. A. Speers	Morecambe	,,

Higher Grade Gas Supply (External Candidates).

A. England	Blackpool	1st Class
W. P. Smith	Bolton	,,
F. S. Charnley	Liverpool	2nd Class
J. L. Goodwill	York	,,
H. Partington	Bolton	,,

Higher Grade Gas Engineering (Internal Candidates).

A. Blenkiron	Bradford	1st Class
G. Gilden	Timperley	,,
A. K. Gould	Shipley	,,
H. Shackleton	Grantham	,,
C. A. Woodhead	Liverpool	,,
C. W. Hemingway	Purston	2nd Class
J. Hinchcliffe	Huddersfield	,,
A. Mawson	Otley	,,
A. Perkin	Northwich	,,
W. Rhodes	Bingley	,,
S. H. Stokes	Elland	,,
C. Wilkinson	Burnley	,,

Higher Grade Gas Supply (Internal Candidates).

H. Ramsden	Halifax	1st Class
J. Hepworth	Huddersfield	,,
R. Boothroyd	Huddersfield	2nd Class

The PRESIDENT, in presenting the certificates, said he

thought that the members of the Association would wish him to express, on their behalf and on his own, how much they appreciated the work which had been done by those who had won the certificates. They had come to look upon those members who were gaining honours in the profession as those who had to take the places of the seniors later on. Without any doubt, the Industry was becoming more technical and more scientific, and was appreciating the assistance that it received from the highly qualified juniors who were entering it. The senior members of the Association regarded it as a great honour to be in a position to grant certificates.

DIPLOMAS IN GAS ENGINEERING.

The President also mentioned the following who had qualified for the Diploma in Gas Engineering:

Diploma in Gas Engineering (Manufacture).

J. J. Brown	Liverpool	2nd Class
J. M. Brown	Liverpool	,,
A. S. Brush	Carlisle	,,
A. W. Elliott	Elland	,,
A. J. Leather	Blackburn	,,

NEW OFFICERS.

The meeting of the Association was subsequently held, when the following were elected to Office:

President.—Mr. F. G. Shaw (Buxton).
Vice-Presidents.—Messrs. A. L. Jennings (Spenborough) and A. L. Holton (Manchester).
Hon. Secretary and Treasurer.—Mr. J. Bridge (Elland).
Committee.—Messrs. T. W. Barratt, A.M.Inst.C.E. (Morecambe), H. Burton (Shipley), and C. R. Ingham (Brighouse).
Auditors.—Messrs. R. B. Braddock (Radcliffe) and Francis Elliott (Leyland).

LOSSES BY DEATH.

The members of the Association stood in silent appreciation of the memory of Mr. F. Pritchard (Huyton), who had been a member since 1881, and who died in May, 1933, and of Mr. E. A. Harman, former Engineer and Manager at Huddersfield, who had been a member of the Association from 1897, and who died on Oct. 17, 1933.

INDUCTION OF NEW MEMBERS.

Three new members were then formally inducted: Mr. J. Hood, Engineer and Manager of the Birkenhead Gas Undertaking; Mr. R. J. Restall, Engineer and Manager of the Stalybridge Gas Undertaking; and Mr. L. Hartley, Director of Messrs. Joseph Clayton & Sons, Leeds.

TREATMENT AND PARTIAL DISTILLATION OF TAR BY HOT CRUDE GASES.

A paper on this subject by Mr. Alfred L. Holton (Chief Engineer, Manchester Corporation Gas Department) was then presented. It will be found, together with a report of the discussion, on later pages of to-day's "JOURNAL."

Another Offer of Gas for Glasgow.

The disposal of the Maclaurin plant at the Dalmarnock Works of the Glasgow Corporation Gas Department was discussed at a meeting of the Sub-Committee on Works and Distribution on Oct. 23.

Some time ago the Corporation decided to dispose of this installation and among the offers in response to their public advertisement was one from Mr. Maclaurin. In making his offer, Mr. Maclaurin said that he was prepared to take over the existing plant and auxiliaries provided the Corporation would guarantee to take from him a supply of gas. The cost of the gas which he proposed to supply would be 1·75d. per therm when treble nut coal costing 17s. 6d. per ton delivered at the works was used. The price of the gas would fluctuate with that of the coal by one-tenth of a penny for each rise or fall of 1s. per ton in the price of the coal. The offer also asked that the amount of gas to be taken by the Corporation should be 1,920,000 therms per annum for the next five years. In addition to paying £1000 per annum towards the purchase of the plant and £500 as a rental for the ground Mr. Maclaurin undertook to pay all rates and taxes on the plant.

A motion that the offer should be put before a special Sub-Committee was raised by Councillor W. Brownhill Smith, but an amendment that the plant should be sold as scrap was carried by 5 votes to 3. At a meeting of the Gas Committee held on Oct. 27 the decision of the Sub-Committee was overturned, and the offer will now be considered by a special Committee. A letter from a gas engineer in New York inquiring about particulars of the plant was placed before the Committee. The nature of the letter showed that the New York engineer intended making an offer on very similar lines to the one made by Mr. Maclaurin.

Radiation Research Kitchen

Press Representatives Witness Interesting Demonstration

On Wednesday last, at the invitation of Messrs. Radiation Limited, a number of Press representatives had the opportunity of inspecting the firm's new Research Kitchen at Radiation House, Grosvenor Place, S.W. 1, and of witnessing some interesting demonstrations, illustrative both of the useful function of this Research Kitchen and, more from the housewife's view point, of the advantages of gas cooking assisted by the "Regulo" oven control.

An illustrated description of this Research Kitchen was given in the "JOURNAL" on the occasion of the official opening by Sir David Milne-Watson, LL.D., D.L. (see July 19, p. 153), so there is little to add now in regard to the actual room itself.

It may be stated, however, that the Kitchen represents in all respects the most modern ideas of construction and fitting. The lighting, which is entirely artificial, gives a very pleasing daylight effect—soft, clear, and closely resembling diffused sunlight—while the ventilation, having regard to the fact that the room has no direct connection with the outside, is excellent, the vitiated air and products from the cooking being drawn away and fresh air circulated. The colour scheme of the tiled walls, ceiling, and flooring is very pleasing, and all the bright fittings are chromium-plated throughout. In addition to complete equipment for the demonstration and testing of recipes, there is also a representative selection of porcelain enamelled "New World" "Regulo"-controlled cookers and ranges. In providing the necessary hot water supply an automatically controlled sink water heater is fitted, while to complete the equipment a gas-operated refrigerator and a labour-saving kitchen cabinet are installed.

NATIONAL IMPORTANCE OF GAS COOKING.

Mr. H. J. Yates, Chairman of Radiation Limited, in the course of a few introductory remarks to those present, emphasized the national importance of gas cooking, and referred to the 17th edition of the Radiation Cookery Book which was shortly to be published. The object of this Kitchen, he said, was to carry out research work and test new recipes, in addition to evolving new menus in co-operation with well-known chefs. Mr. Yates also took the opportunity of thanking Sir Francis Goodenough for his presence on that occasion and for his interest in their venture.

Sir Francis Goodenough remarked that he was only too pleased to be able to associate himself with the scientific work of Radiation Limited in the cause of the advancement of good cooking. The trend of modern industry and commerce was to harness science in the service of men and women, and he felt that the community should be indebted to these manufacturers who spent a great deal of money experimentally in trying out every possible method of rendering their apparatus more useful. In this respect Radiation Limited took a particularly prominent part among the manufacturers in this country. Those present were observing on that occasion how thorough were their efforts to make their gas cookers of the greatest possible utility to the housewife. Gas cooking, said Sir Francis, really revolutionized domestic life, particularly that of the working man, and there were to-day between four and five million homes of the artizan class using gas for cooking. The gas cooker, he concluded, had been enormously improved in recent years, and was a really scientific piece of apparatus for cooking food in a simple and straightforward way.

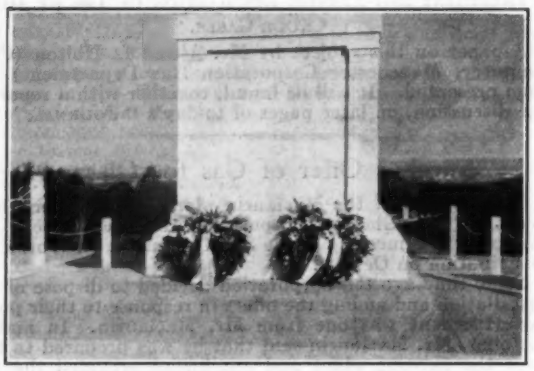
After Mr. Yates had briefly thanked Sir Francis Goodenough for his remarks, the company adjourned to the Research Kitchen, where Miss Kirkby, the Company's cookery expert, gave some interesting and practical demonstrations in preparing quickly and efficiently a number of appetizing breakfast dishes with the use of the gas oven and appropriate "Regulo" settings.

Those present were subsequently entertained at tea at the kind invitation of the firm.

IN WASHINGTON AND BALTIMORE

WITH MEMBERS OF THE I.G.E.

BY THE EDITOR



Tomb of the Unknown Soldier, in Arlington National Cemetery,
Showing Wreaths deposited by the British and the French Visitors.

Stately Washington was reached in the early morning of Sunday, Oct. 1, after a night journey of 370 miles from Pittsburgh. Our tour included a number of these night journeys, which were made far more comfortable than otherwise would have been the case by the fact that two-berth sleeping compartments were provided for our use, in place of the standard sleeping coaches of that part of the world. In the amazing Union Railway Station (where, early as it was, we found members of the local Reception Committee awaiting us) we had, upon arrival, an arresting example of what we were to expect in Washington. The length of the structure is no less than 760 ft., and the width nearly half as much. The material used for the exterior is white granite. The "passenger concourse," through which people pass to the trains, is said to be the largest room in the world under one roof, and it is calculated that an army of 50,000 men could stand upon its floor. Though the Washington Station may be exceptional, we were struck, in place after place that was visited, by the spaciousness and the handsome character of the stations, upon which vast sums of money must have been expended.

Breakfast was followed by an inspection of the Folger Shakespeare Library, the Director of which honoured us by devoting his Sunday morning to showing us round. The library owes its origin to the benevolence of a wealthy lover of Shakespeare, who contributed his rare collection of books and endowed the building. Incorporated is a theatre, with a Shakespearian stage, but provided with modern lighting and seating accommodation. The exterior of the building is of white marble, with carved characters and quotations from Shakespeare's plays; the effect being extremely beautiful. Next the British delegation was escorted to the British Embassy, and the French delegation to the French Embassy.

Arlington National Cemetery.

The drive in the afternoon was first to the Arlington National Cemetery, in Virginia, on the heights of the Potomac, opposite Washington. Here, in what must surely be one of the most beautiful cemeteries in the world, is the Tomb of the Unknown Soldier. "Here rests in honoured glory an American Soldier known but to God." Wreaths were deposited by Mr. Tarratt, on behalf of the Institution of Gas Engineers, and by M. Baril, on behalf of the French Society.

Thereafter the drive was resumed, in brilliant sunshine, and with a temperature of round about 89° in the shade (the precursor of a somewhat heavy thunderstorm in the early evening), we passed the White House, the home of the President, on Pennsylvania Avenue, and greatly admired its handsome architecture. It is outstanding, in a city of beautiful buildings, very many of which are of white material. The White House was the first public building erected in Washington; President Washington having laid the cornerstone in 1792. President John Adams was the first occupant in 1800, and his successors have lived there, so that the White House is associated with all the Presidents. The Capitol—an equally, or more, beautiful building, of sandstone, with extensions of marble, the cornerstone of which was laid by President Washington in 1793—received its due meed of praise, as did also the Lincoln Memorial, which is in form a Greek temple, of pure white marble. In this Memorial, the Union is expressed by a colonnade of 36 Ionic fluted columns, one for each State in the Union at the time of Lincoln's death. In the central hall is a colossal statue of Lincoln. The treasures of Washington would take long to explore; we, unfortunately, had but a few hours there. But we saw the city and its glistening white buildings, its wide and dignified thoroughfares, under ideal conditions, and the impression made was deep.

Towards the end of our drive we had an opportunity of seeing Ford's Theatre, during a performance at which President Lincoln was shot by Wilkes Booth, in April, 1865, and also the house on the opposite side of the street, to which he was immediately taken, and where he died early on the following day. Abraham Lincoln, says John Finnemore, "was the most striking and remarkable man that America has ever produced, and—saving Washington alone—the greatest."

Washington's Home.

Mount Vernon, the home of Washington, is on the Virginia shore of the Potomac, 16 miles south of Washington, and, of course, without mention of it no reference to the city would be complete. The house was built nearly 200 years ago by a half-brother of George Washington

In Arlington Cemetery.
From Left to Right: Mr. F. P. Tarratt, M. A. Baril, Mr. J. R. W. Alexander, Mr. W. E. Dean, Mrs. Thomas Glover, and Mr. Thomas Glover.

named Lawrence, and it was named Mount Vernon in honour of Admiral Vernon, under whom Lawrence had served. Later Washington inherited the estate, on which he lived until his death in 1799. About 60 years after this, the estate (which by then had fallen into a condition of neglect and partial ruin) was acquired by public subscription as a permanent shrine of patriotism, and a scheme of restoration was undertaken. Furnishings originally there, and others of like character and dating from Washington's time, have been brought there; and every effort has been put forth to make the Mount Vernon of to-day as closely as possible Mount Vernon as Washington knew it.

Washington's Gas Supply.

Up to about three years ago carburetted water gas with a heating value of 600 B.Th.U. was produced by the Washington Gas Light Company. At that time a natural gas supply became available, and since then natural gas has been used to enrich a lightly carburetted water gas, without any change having been made in the heating value standard of the gas s pplied to the consumers. The Com-

pany, therefore, at the present time produce a lightly carburetted blue gas, enriching this to 600 B.Th.U. with natural gas. The materials used are coal and coke, about 50% of each. The carburetting oil is a topped crude.

The distribution system of the Company is the conventional low-pressure system, reinforced at many points by means of intermediate pressure lines controlled by field governors.

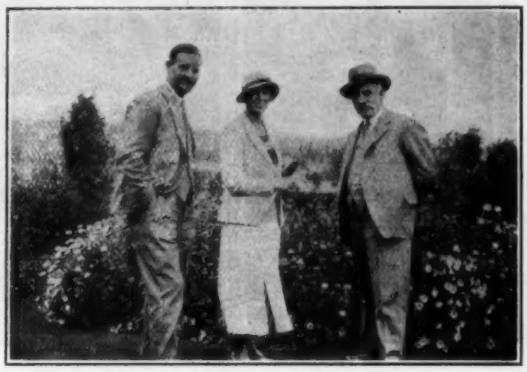
BALTIMORE.

Baltimore—a city of some 800,000 inhabitants—which was next on our itinerary, is but a short railway run from Washington, and early on the Monday morning we found ourselves the favoured guests of the Consolidated Gas, Electric Light, and Power Company of Baltimore, first of all at their Spring Gardens Gas Manufacturing Plant. We had, in fact, been accompanied on our way from Washington by Mr. H. R. Cook, Jun., the General Superintendent of the Baltimore Consolidated Company's Gas Operating Division. The biggest holder at the Spring Garden Works has been christened—in huge white letters on the sheeting—the "Fuel Bin of Baltimore," and a study of the Company's operations shows the title to be well justified.

The First Gas Company in the United States.

In Baltimore we were again on historic ground, especially so far as the Gas Industry is concerned, for the Consolidated Company was founded there in 1816, and was the first Gas Company in the United States. Since that time the Consolidated Gas, Electric Light, and Power Company of Baltimore, and its antecedents, have been in the service of the people of Baltimore, and during the past quarter of a century the present Company has supplied both gas and electricity to the community. For twenty-three years the present management (with Mr. J. E. Aldred as Chairman of the Board) has been in control of operations—a time which has embraced the periods of the greatest prosperity and greatest depression of business in the whole history of Baltimore.

At the close of 1929 there was a general reduction in the Company's rates, so that the undertaking entered the cycle of depression with lowered schedules of charges for its services. And while the service is cheaper, it is also better. At no other time in its history has the Company had the facilities with which it is serving its customers to-day. Its sources of energy, its distribution systems, its methods of conducting its business to serve better its customers at the lowered rates, have been expanded and improved. Prevented by the economic impasse from immediate growth of industrial business, the Company has diligently and



Mr. D. F. Irving, of Leatherhead, Mrs. Irving, and Mr. W. B. Reidie.

Mr. Reidie (on the right) is retiring from the position of Station Engineer at the Bromley-by-Bow Works of the Gas Light and Coke Company.

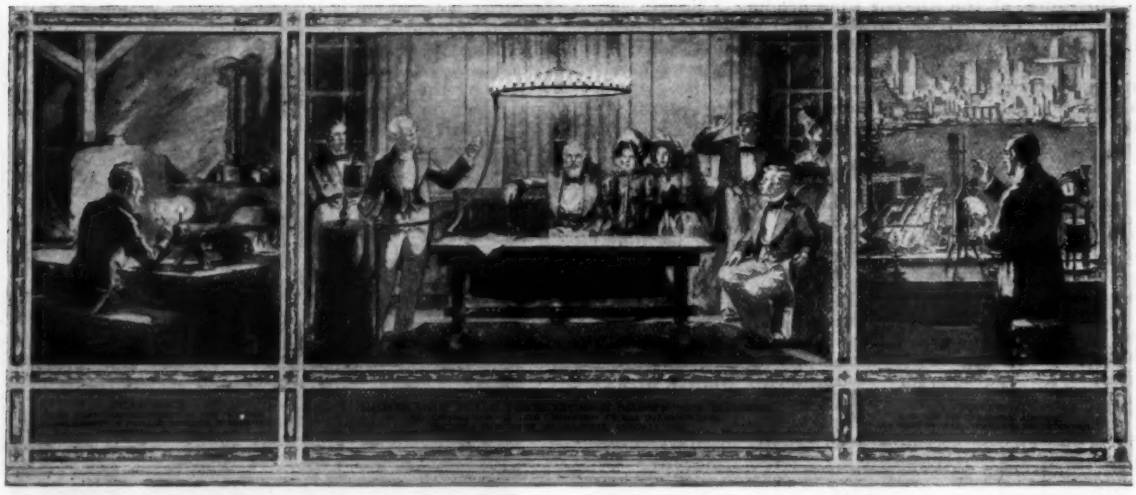
methodically applied its efforts to the development of other branches. For example, it is estimated that 56,000 electric refrigerators are in use on the premises of the Company's customers. This important load has developed practically within the past five years, and will continue to grow.

The territory served with gas has expanded from 145 sq. miles in 1928 to 210 sq. miles in 1932, and in accomplishing this the longest extension has been only 19 miles. To meet the growth of the use of gas in the northern section of the City, the Company erected and placed in service during 1932 a new holder station. This additional storage will provide better service for 100,000 people in

[*Photo. Wood Aerial Surveys, Inc.*

SPRING GARDENS GAS MANUFACTURING PLANT.

All of the gas sold by the Consolidated Company is distributed from this modern plant which has a daily capacity of 76,000,000 c.ft. The plant receives large quantities of bye-product gas from the coke ovens of the Bethlehem Steel Company at Sparrows Point near Baltimore.



COMMEMORATING REMBRANDT PEALE'S USE OF GAS FOR LIGHTING IN 1816.
A Painting by R. McGill Mackall.

that section of the city, and meet the increased demands for the household use of gas for heating homes, heating water, cooking, and other domestic purposes.

Low Rates for House Heating.

The Company was a pioneer in the introduction of low rates to encourage the use of gas for house heating. Baltimore's moderate and variable climate and the Company's very low rates—as low as 55 cents net for house heating—combine to make the automatic heating of homes with gas an important and growing factor in the Company's business. Some 3900 homes and buildings are heated entirely by gas supplied by the Company, and many thousands of homes use gas for auxiliary house heating.

An innovation in the Company's methods of securing new house-heating customers has been the active sale during the past year of conversion burners. The installation cost of this burner is small, and the Company accepts payment in monthly instalments. The burner is installed in existing coal-burning furnaces, and avoids the necessity on the part of the customer of investing in a new boiler. The Company sells about one million dollars' worth of gas annually for house heating—the growth of this end of its business having reached a point where it now produces about 12% of the Company's revenue from the sale of gas.

Quite lately the Company has purchased the Havre de Grace Gas Company, and, by means of a main extension through territory which provided additional customers, has effected an inter-connection of its distribution system with that of the Havre de Grace Company. Havre de Grace is 38 miles from Baltimore. Relatively short extensions a few years ago connected the Baltimore system with Annapolis and Laurel, with the result that the Company's system now extends a distance of 66 miles.

The gas supplied is practically half-and-half water gas and coke oven gas. Coke, of course, has to be bought to manufacture the water gas; no coal being carbonized. There is also a certain quantity purchased of oil refinery gas. There are thousands of street gas lamps in Baltimore, and electric lamps in addition. The Consolidated Company's activities include gas, electricity, and a central steam supply. There are 7½ miles of steam mains, both high and low pressure. The high pressure steam is in use all the year round; the low pressure supply is for winter heating.

The go-ahead policy of the Company is exemplified by the big showrooms, fully equipped with the most modern appliances. At the time of our visit, these showrooms, in the central part of the city, wore a most animated appearance. The distribution offices and shops of the Company were also open to inspection, and arrangements were made for those interested to visit local manufacturing plants—among others, the Bartlett Hayward Company, the Maryland Meter Works, and the Standard Gas Equipment Corporation.

Another Record.

All of us were pleased to have an opportunity of visiting Peale's Museum—the first building in Baltimore to be lighted by gas, and of seeing there the painting by R. McGill Mackall, commemorating Rembrandt Peale's use of gas for lighting his museum in 1816, which was a few months ago presented by a group of donors to the museum—the Baltimore Municipal Museum is now its title. On that occasion, Mr. Charles M. Cohn, Vice-President of the Consolidated Company of Baltimore, explained that out of the display of gas lighting arranged within the museum by Rembrandt Peale Baltimore gained the distinction of being granted the first franchise for the supply of gas in America.

Rembrandt Peale was a distinguished member of an illustrious family of artists associated with Maryland and Pennsylvania in the 18th and 19th centuries. Born in 1778, at the age of 17 he had obtained a sitting from George Washington. In 1801 he came to England, where he pursued his studies. Three years later he was in Philadelphia, and in 1807 he was in Paris, painting portraits there. Later he moved to Baltimore and established a museum and gallery of paintings. His death occurred at Philadelphia in 1860.

Mr. B. R. Parkinson, an "Able-Bodied Seaman," and Mr. H. E. Bloor,
Aboard the s.s. "Duchess of York" in mid-Atlantic.

In connection with the exhibition of "the ring beset with gems of light" in his museum in 1816 we have Peale's announcement over his name as it appeared in the *American and Commercial Daily Advertiser of Baltimore* on June 13, 1816.

"Gas Lights."

Without Oil, Tallow, Wick, or Smoke.

> It is not necessary to invite attention to the gas lights by which my saloon of paintings is now illuminated; those who have seen the ring beset with gems of light are sufficiently disposed to spread their reputation. The purpose of this notice is merely to say that the Museum will be illuminated every evening until the public curiosity shall be gratified.
>
> Rembrandt Peale.

Four days later an ordinance authorizing the Gas Light

Company of Baltimore to lay pipes was passed by the Baltimore City Council. The charter of the Company was enacted by the General Assembly of Maryland on Feb. 5, 1817.

"THE STAR-SPANGLED BANNER."

But this very far from exhausts Baltimore's claims to greatness. It was by Fort McHenry, at the entrance to Baltimore's upper harbour, that Francis Scott Key (a young Baltimore lawyer), early in the morning of Sept. 14, 1814, wrote "The Star-Spangled Banner." This was at the time when the British fleet made its unsuccessful attack; the story, in brief, being as follows: With a friend Key visited the English flagship to secure the release of a prisoner, and was himself held prisoner temporarily. All night long he listened, as shell after shell went screaming toward the fort. As daylight approached, the bombardment ceased. Key thought the fort had surrendered, but as the first streak of dawn appeared in the east, he saw the flag waving triumphantly in the breeze. In joyous relief, he pulled an envelope from his pocket and jotted on the back the first stanza of "The Star-Spangled Banner." Later in the day, when the battle had come to a victorious end, he finished his poem.

There is also to be seen the grave of Edgar Allan Poe, who died in Baltimore in 1849, at the age of 40.

Baltimore is enchantingly situated, and possesses a chain of parks consisting of approximately 3000 acres. For lunch we were taken by our hosts to the Baltimore Country Club, which is in the wealthy portion of the city, amidst scenery of outstanding grandeur. Mr. C. M. Cohn, Vice-President of the Consolidated Company, was in the chair, and told us of Baltimore's pride in possessing the first Gas Company in the United States. The Mayor of Baltimore also extended greetings to the visitors. Mr. Tarratt, in the course of his acknowledgment of the hospitality accorded us, pointed out that we had seen—as undoubtedly we had—ample evidence of the fact that the gas and electricity supplies of Baltimore are in good hands.

Before leaving on our next stage—to Philadelphia—we were taken to see the famous Johns Hopkins University and many beauty spots of which Baltimore is so justly proud. So that an enjoyable day terminated upon a note of admiration.

New Plant at Darwen

Inauguration by Sir Herbert Samuel

The official inauguration of an installation of vertical retorts and auxiliary plant, together with re-built gasholders, at the works of Darwen Corporation, took place on Oct. 25, the ceremony being performed by the Rt. Hon. Sir Herbert Samuel, G.C.B., M.P. for the Darwen Division.

Alderman George Pickup, Chairman of the Gas Committee, presided over the day's proceedings and was supported by the Mayor of Darwen (Councillor Wm. Jessop) and a distinguished company of about 130 representatives of gas undertakings, and gas engineers and managers, from many parts of Lancashire, Cheshire, Yorkshire, and North Wales.

The formal welcome, by Alderman Pickup, was brief and the ceremony in which Sir Herbert Samuel started the carbonizing plant was, in view of the keen weather conditions, of equal brevity, Sir Herbert's speech being reserved for the subsequent luncheon gathering. Before adjourning for lunch at the Criterion Restaurant the party spent well over an hour inspecting the new equipment.

DARWEN'S GAS-WORKS.

The Over Darwen Gas Lighting Company was formed in 1838, and in 1872 the Local Board of Health completed negotiations for the acquisition of the undertaking, which they took over in the following year. The annual make of gas at this period was 51,440,000 c.ft., and the price 4s. 9d. per 1000 c.ft.

RECONSTRUCTION.

Mr. A. F. Ames, the present Engineer and Manager, was appointed in 1931, and following upon a report submitted by him to the Gas Committee, it was decided to discard the Munich chambers installed in 1912 and to erect a vertical retort installation, and carry out other necessary improvements to the works and plant. After careful investigations it was decided to let the contract for the vertical retorts, complete with waste-heat boiler, to Messrs. Drakes, Ltd., of Halifax. An inquiry by the Ministry of Health was held on April 12, 1932, and sanction was received to proceed with the work on June 13, 1932.

Messrs. Drakes, Ltd., commenced work on their contract on June 15, 1932, and gas-making commenced in the new vertical retorts on May 2, 1933. The Munich chambers were closed down the same day. The contractors have carried out the work in the capable manner expected of them, without hitch of any kind, and within the time specified. They have spared no pains to make the installation one of the best of its kind, and the plant is giving every satisfaction.

The remaining portion of the reconstruction work was let to Messrs. R. & J. Dempster, Ltd., of Manchester, who have erected a water-cooled condenser, P. & A. tar extractor, and gas heater, and also carried out extensive renewals and repairs to both gasholders. This work has been carried out expeditiously and in an excellent manner, and the contractors deserve credit for carrying out the repairs and adjustments to the gasholders and guide framing so satisfactorily, thus putting the holders, which were in a very bad state, into a sound and serviceable condition again.

CARBONIZING PLANT.

The carbonizing plant is installed in part of the existing horizontal retort house on new mass concrete foundations. The new carbonizing plant comprises four settings of Drakes patent continuous vertical retorts, draughted on their new system of upward heating. Each setting contains four retorts in units of two, each chamber being provided with an independent gas and air supply with dampers and regulators grouped in most convenient and accessible positions which permit of the setting temperatures being easily regulated to suit the varying throughput to meet the seasonable demands for gas.

Each retort has a guaranteed throughput of 4 tons of coal per diem. The retorts are 45 in. by 21 in. at the base, tapering to 36 in. by 12 in. at the top, and are 24 ft. 6 in. long over-all. Throughout the entire heating zone the retorts are constructed of Meltham toughened silica material, the combustion chambers and the setting linings being of the same quality material.

All the walls are insulated with Moler non-conducting bricks, and sight boxes are arranged in the front walls at frequent intervals to permit of proper inspection of the temperatures throughout the length of the retorts.

The producers are arranged on the ground floor in front of the settings and are of ample capacity and fitted with Drakes patent hanging-bar grates of large area, which minimize the formation of clinker and have proved to require very little attention, resulting in a fuel consumption of approximately 11 lbs. of coke per 100 lbs. of coal carbonized.

The whole of the firebrick material used in the construction of the producers and settings is of the highest quality and was supplied by Messrs. John Morton & Co., Thornton, near Bradford.

The whole of the setting and producer structure is of a substantial nature and arranged to permit of expansion of the brickwork without placing undue stress on any members. The plant is also surrounded by spacious platforms arranged at convenient heights for inspection purposes, access to same being by easily graduated staircases.

The coke chambers and extractors are of Drakes standard design, the discharging doors being of the self-sealing pattern.

The throughput of each retort is separately controlled by a ratchet and mask device. Superheated steam is admitted into each retort through a specially fitted nickel bush device and controlled by the Simplon steaming appliances.

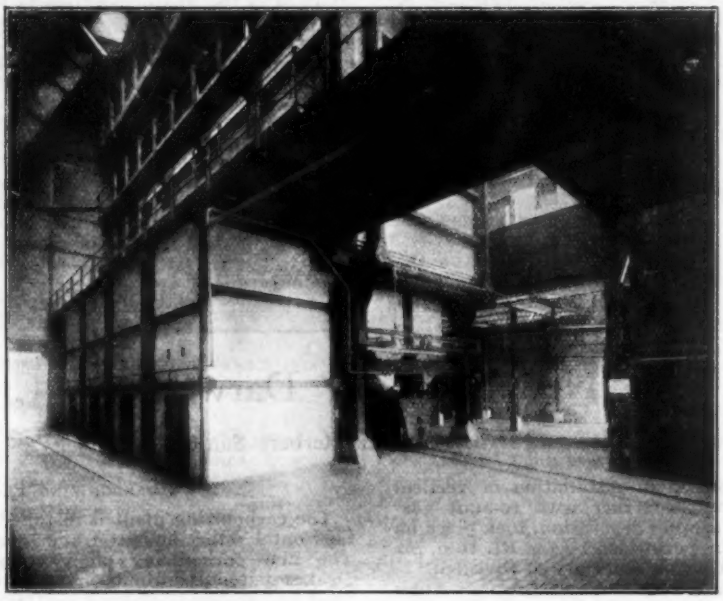
The governing of the gas emanating from the retorts is accomplished by an Arca hydraulic regulator fitted with gravel filter and attached to a 14-in. butterfly valve.

A notable feature is the charging platform, which is exceedingly spacious, efficiently lighted and remarkably cool, permitting the men to carry out their duties in an atmosphere of comfort.

COAL AND COKE HANDLING PLANT.

The coal storage hoppers are carried on a substantial structure and are formed of strong plates and angles, and are of 48 hours' capacity. The coal is received into the

works on an overhead gantry in the coal store adjoining the retort house, and is conveyed to the hoppers by a jigger feed surmounting the crusher fitted with by-pass chutes, and is raised by a continuous bucket elevator to a drag-bar conveyor for distributing the coal throughout the entire length of the storage hoppers.



GENERAL ARRANGEMENT ON GROUND FLOOR.

Showing Producers, Coke Extractors, Platforms, Main Flue, Electric Lift, &c.

The whole of the plant is electrically driven by motors supplied by the Lancashire Dynamo Company.

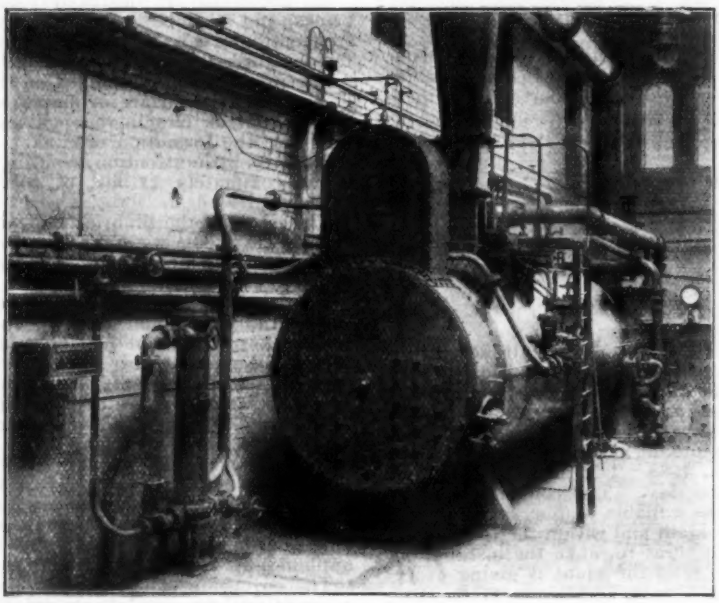
The coke from the extractors is transported outside the house in telpher skips conveyed on bogies, and is then handled by the existing telpher plant, the structure of which has been extended to suit the altered conditions.

The existing coke screening plant was entirely replaced with Drakes Zimmer screens, new structure being provided and the existing hoppers re-arranged to suit the various grading. The coke is graded into five different sizes.

Waste-Heat Boiler.

The waste gases leaving the combustion chambers of the carbonizing plant pass through a steel-cased insulated flue to a standard Spencer-Bonecourt patent high-velocity fire-tube waste-heat boiler. The boiler is 5 ft. 6 in. in diameter, has a heating surface of 1220 sq. ft., and gives steam at 120 lbs. pressure superheated 100° F.

The boiler follows standard Spencer-Bonecourt practice throughout, and is fitted with a "Sirocco" induced draught fan, which is driven by a geared De Laval turbine. The exhaust steam from the turbine passes through a surface type feed water heater, so enabling the bulk of the heat used for driving the fan turbine to be returned to the boiler circuit as hot feed. The boiler feeding arrangements consist of two Weir pumps—one acting as a stand-by—and feed control is entirely automatic. The superheater is of the Spencer-Bonecourt radiant-heated type—*i.e.*, avoiding the actual flow of hot gases through the superheater coils.



WASTE-HEAT RECOVERY PLANT.

When the plant is carbonizing 64 tons per day, the boiler output is approximately 3600 lbs. of water per hour, actual.

An auxiliary producer of Drakes' design and manufacture is installed to work in conjunction with the boiler for the purpose of maintaining the maximum boiler output

when the carbonizing plant is on its minimum load. This plant can be put into full operation at very short notice, and has been found a very valuable asset, maintaining a steady supply of steam at a remarkably low cost.

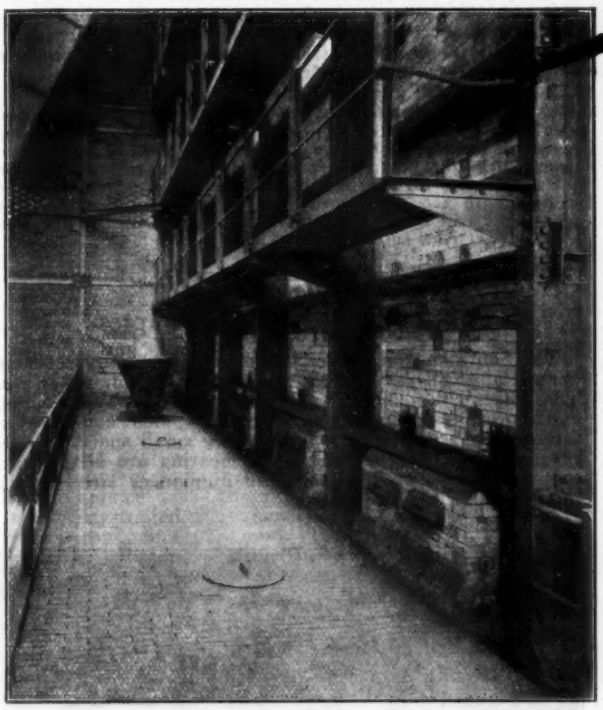
Electric Lift.

An electric lift capable of lifting a maximum load of 20 cwt. is arranged at one end of the retort house. The lift is installed for passenger service and for use in the event of a breakdown of the mechanical coal and coke plant. The electric lift was manufactured and installed by Messrs. E. A. Foulds, Ltd., Engineers, Albert Works, Colne.

The extractor engine house is situated in line with the extractors, the drive for the latter being derived from two 5-h.p. Bryan-Donkin exhauster type engines—one as stand-by. These engines are steam driven.

Condensers, &c.

From the retorts the gas passes through a great length of foul main, approximately 180 yards, to the lower yard level, to a set of atmospheric condensers. As these were inefficient a horizontal inclined water-tube condenser, made and erected by Messrs. R. & J. Dempster, Ltd., has been added. The capacity of this condenser is 1 million c.ft. per day, and it is capable of cooling the gas from 140° to 65° F.



Producer Charging Stage.

The exhauster house contains two sets of steam driven exhausters: A Bryan-Donkin, two blade type, capacity 80,000 c.ft. per hour; and a Waller, four blade type, capacity 50,000 c.ft. per hour.

The tar extractors consist of a P. & A. recently erected by Messrs. R. & J. Dempster, Ltd., of a capacity of 1¼ million c.ft. per day, together with a Livesey of a capacity of 2 million c.ft. per day.

The oxide handling plant consists of a steam-driven elevator and a Crone and Taylor petrol-driven dis-integrator.

To assist in maintaining the gas at a suitable temperature for efficient purification, a steam heated gas heater has been fixed on the inlet to the purifiers, and this has already been of great assistance in reducing purification costs.

Statistical.

The gas made during 1932-33 was 192,028,000 c.ft.

There are 51 miles of mains in the district and 11,287 consumers, of whom 7505 have ordinary meters and 3782 slot meters.

After completing the extensions and renewals to the works, the net indebtedness of the Department is £25,000, which is equal to £150 per million c.ft. of gas sold.

The capacity of the plant, now that the extensions are completed, is equal to an increase in consumption of 40%.

LUNCHEON SPEECHES.

Alderman Pickup presided at the luncheon. The Town Clerk (Mr. C. C. Byers) reported that a number of apologies for unavoidable absence had been received, but he particularly wished to mention that of Mr. C. F. Spencer, Chairman of Directors of Messrs. Drakes, Ltd., who had been taken suddenly and rather seriously ill the previous day and to whom they would all wish a speedy recovery [" Hear, hear "]; and of Mr. George Dixon, Engineer and Manager to Nottingham Gas Department, who was well-known in Darwen as a former Consultant to their Gas Department.

Sir Herbert Samuel, called upon for his inaugural speech before opening the after-lunch toast list, said he was proud to know that the Gas Department of the town he represented in Parliament had been in operation, with periodic improvements and enlargements, for close upon a hundred years and now catered for 11,000 consumers, all of whom, he was satisfied, were receiving a service for which they might well be thankful. [" Hear, hear."] Quite apart from the many services which gas and the bye-products of its manufacture could render to the community in a direct manner, it attracted him especially because of the big part it played in the matter of atmospheric purification. He recalled that in 1925 and 1926 he had the honour of presiding over a Royal Commission on the Coal Industry. " My colleagues on that Commission, like myself," said Sir Herbert, " were very much impressed by the importance of the treatment of coal instead of the wasteful and injurious methods of utilization by burning raw coal. We were impressed for many reasons, one of the chief of which was that of purification of the air over our towns. We found a Departmental Committee of 1921 had expressed themselves satisfied, after very careful inquiry, that domestic smoke caused by the burning of raw coal in household fires caused very serious damage both to public health and to property. That Committee had reported, as a result of scientific investigation, that in the open country there was 20% more sunlight than in the average smoky town, and that there was a very close relationship between public health—particularly in regard to pulmonary diseases—and the pollution of the atmosphere by smoke. We found also that millions of tons of good fuel were being wasted into the air as smoke, doing damage instead of rendering service. My Commission entirely endorsed the views of the earlier Committee in that respect. ['Hear, hear.'] The more gas is consumed—and electricity consumption also, if you like, because that also plays its part to the same desirable end—the more the nation is saved from that vast wastefulness and that serious injury. It has been estimated, I believe, that the housewives of this country, under the burden of the system of burning raw coal, spend something like £290,000 per year in domestic washing, a great deal of which should not be necessary."

If the fact that Darwen had 11,000 gas consumers (proceeded the speaker) meant that the town was avoiding something approaching that number of coal fires each winter and a large number in summer, then the plant which he had had the honour to start that day was one of which they should be justly proud for the service it was rendering in keeping a cleaner atmosphere, as well as its more direct services. [" Hear, hear."] Sir Herbert said he was glad to know that progress in the extension of gas supply at Darwen had not been retarded by the great depression which had of late years affected the cotton industry, on which the people of Darwen so much depended. In Darwen, he learned, the price of gas to consumers had been reduced during the past year, and they had changed a previous loss to a profit of some £3500. Although they had spent money on their up-to-date new plant, the total indebtedness of the undertaking was only £25,000, equal to £150 per million c.ft. of gas sold, so that the new asset represented more than the total debt. That, he thought, was a highly creditable position, and he had no doubt it was due in large measure to the wise policy and efficient management of their Engineer and Manager, Mr. A. F. Ames. [Applause.] All concerned should also be grateful, continued Sir Herbert, for the efficient and admirable manner in which Messrs. Drakes, Ltd., and Messrs. R. & J. Dempster, Ltd., had met their responsibilities as contractors in the new scheme. [" Hear, hear."] The Mayor and Corporation of Darwen, concluded Sir Herbert, might justifiably look on the new undertaking with pride and the town would welcome it with gratitude.

Councillor T. E. Holgate, J.P., A.R.S.M. (Vice-Chairman of the Darwen Gas Committee), proposing a vote of thanks to Sir Herbert Samuel for starting the new plant, said the town had every reason to be thankful for a new installation which gave about 50% greater output of gas than the old plant and at materially less labour cost. It was a plant, he felt, which was genuinely admired by those fully conversant with the technicalities of such equipment, and one which would have a high reputation in gas circles.

Alderman Roger Marsden, J.P., seconding, said Darwen had a fine works and a fine Manager. One of the main factors of a big equipment of this kind was that of finance; and as one who was keen on that aspect of any public undertaking he (Alderman Marsden) felt satisfied this scheme was sound finance as well as progress.

A Noteworthy Enterprise.

Mr. Samuel Tagg, M.Inst.C.E., J.P. (Engineer and Manager to Preston Gas Company and Past-President of the Institution of Gas Engineers), proposing a toast to the Darwen Corporation

Gas Department, said the privilege of proposing that toast afforded him a welcome opportunity of adding his congratulations on a noteworthy enterprise. Darwen Corporation were to be complimented on so readily accepting a progressive policy which in the short space of two years had borne such remarkable fruit. Speaking from an engineering point of view, he regarded the new plant as an excellent piece of work and one which reflected great credit on the Engineer responsible for its conception and on the contractors who had carried it out. ["Hear, hear."] In view of existing circumstances, the enterprise also was distinguished by its courage. In the last few years there had been big developments in electricity, and that factor must have given the Darwen Gas Committee a good deal of food for thought when facing the problem of a considerable capital expenditure on reconditioning their gas-works. The decision they reached and the policy they had carried out, suggested Mr. Tagg, were not only courageous but were undoubtedly wise and prudent. Those who were responsible for the desire to accelerate the use of electricity in this country had the goodwill of all who were anxious to secure cheap power to alleviate the work of the housewife, but it should not be overlooked that for most of such purposes gas would give an equal service and in most cases at a lower cost. ["Hear, hear."] A cheap and abundant supply of gas, he would suggest, was as much a necessity for the well-being of the community as an efficient electrical service. Darwen Corporation could draw comfort and confidence from the abounding evidence of a public desire for extended use of gas, for the demand was never greater than to-day. ["Hear, hear."] As an illustration he mentioned that in his own district of Preston gas appliances had been installed in 80% of the new houses, despite a restriction placed by an electricity-owning Corporation on the use of gas in municipally-built houses. There were many things for which gas could not possibly be replaced by electricity; and those responsible for gas undertakings were fulfilling a public duty when they put into being a carbonizing plant designed to supply gas of a uniform quality at the lowest possible price to the consumer, as had just been done at Darwen.

Alderman GEORGE PICKUP, responding to the toast, testified to the excellent manner in which the contractors' work had been carried out and the short time in which it was done. The new plant, as Sir Herbert Samuel had remarked, was a big factor in aiding cleanliness of the atmosphere.

Councillor ALBERT DUCKWORTH, proposing a toast to "The Contractors," remarked that they had now got a most up-to-date and highly efficient gas undertaking, and they were satisfied they had placed the contract in the hands of two of the most reliable firms in the country, firms whose reputations would be enhanced by the work they had done at Darwen. [Applause.]

Mr. M. T. THOMPSON, Director and Joint General Manager of Drakes, Ltd., said he greatly regretted the circumstances of Mr. C. F. Spencer's sudden illness. The contractors highly appreciated the honour of having their new plant opened by so distinguished a personage as Sir Herbert Samuel, to whom they expressed their warm thanks for the time he had devoted to the purpose. The contractors were proud of the Darwen plant. It was one of their latest type, and the results from its working so far had easily exceeded their guarantees. The confidence of the management of the undertaking was evidenced by the fact that the old plant was put out of commission the very day the new one started gas-making. Machinery to-day was well housed, and they were in a better position than ever before to supply gas at a very low cost under ideal conditions. The firm of Drakes had been in the carbonizing business for upwards of 100 years, and all the experience of those years was put into the modern installations they produced for the carbonization of coal. The plant was Drakes' own patent and was manufactured at their own works, and he was quite confident it could be relied upon to give the best possible service. Mr. Thompson said he was more than surprised the Government had not taken a more active interest in the matter of utilization of gas as a transport fuel. In expressing the thanks of the contractors for the toast and the tributes paid to the work, he wished to acknowledge indebtedness to Mr. Ames, the Darwen Gas Engineer and Manager, for the most friendly co-operation throughout. [Applause.]

Mr. Thompson presented a silver rose bowl to Alderman Pickup, the Chairman of the Gas Committee, as a little memento of the occasion on behalf of both firms of contractors.

Alderman PICKUP suitably responded.

Mr. J. WINSON SCOTT, Director of R. & J. Dempster, Ltd., also responding to the toast of "The Contractors," said the work undertaken at Darwen was by no means a simple job. The chief problem which his firm had come up against had been that of tackling the old gasholders, but they had been put into thoroughly sound condition, and they would serve well for many years to come. "Darwen," said Mr. Scott, "is to be congratulated on the tremendous transformation it had brought about at its gas-works. I wish to thank Mr. Ames and the members of his staff for their ready and willing help in problems and difficulties which have sometimes arisen unexpectedly and when their direct co-operation had been of great value. So far as concerns the new retort installation, I am old enough to recall Jonas Drake, the founder of the firm of Drakes, Ltd., when he set retorts himself in the 80's. His sons and grandsons were brought up in the job; and as a Director of a competitor firm—for we are competitors in many ways, although working together on this job at Darwen—I wish personally to congratulate Messrs. Drakes, Ltd., on the general excellence of their work as well as on this particular job."

The MAYOR OF DARWEN (Councillor W. Jepson, J.P.) proposed a brief but cordial toast to "The Visitors."

Alderman J. E. KEIGHLEY, J.P., Chairman of the Colne Corporation Gas Committee, responding on behalf of gas authorities, said if Darwen had had difficulties they could be all the more proud of the result now achieved. ["Hear, hear."] Alderman Keighley said he agreed that gas and electricity should be able to work side by side for the public good, but one would like to see the Gas Industry given the same help and encouragement from the Government that electricity received. The Gas Industry had not only to face a competitor; it had to face privilege and prejudice and anomalies in the law in the way of restrictions remaining long after they were justified.

Mr. F. G. SHAW, Engineer and Manager to the Buxton Corporation Gas Department, responding to the toast on behalf of the technical visitors, congratulated Darwen on having the interest and sympathy of so prominent a stateman as Sir Herbert Samuel. The Gas Industry in general needed more sympathy from politicians in bringing about the removal of out-of-date legislation, the continued operation of which was a great injustice to a valuable and important Industry working under a totally unfair handicap. Those present who were working professionally in the Gas Industry were particularly glad to have Sir Herbert Samuel's assurance of his appreciation of the work the Industry was doing and to feel that its urgent needs in the matter of revised legislation to suit modern conditions would have his powerful support as a great leader in the national life.

Mr. Shaw said enough had been spoken that day to confirm the faith in the future of gas so splendidly demonstrated in the new carbonizing plant installed at Darwen. Their Engineer, Mr. Ames, had had a lot of leeway to make up, and was to be congratulated on the results he had attained. To turn a loss of £1691 in the year 1931 into a profit of £3561 for the past year, together with a reduction in the price of gas costing the Department £2980, was excellent.

Alderman PICKUP, before closing the proceedings, proposed a special personal toast to Mr. Ames.

Mr. AMES, who was given a rousing reception, said he was glad to have the opportunity of thanking the Chairman and members of the Gas Committee for the confidence they had placed in him in this scheme; to the Town Council for its confirmation of the Committee's approval of the scheme; and to the contractors for the harmonious manner in which they had worked with the Department and its staff throughout. The new plant had done more than was claimed for it, and had already effected a satisfactory saving.

All-Gas House at Southampton.

The Southampton Gaslight and Coke Company recently opened an "all-gas" house on a newly developing estate. The house is a splendid example of a labour-saving home, and shows how a comprehensive gas equipment can be satisfactorily arranged in a comparatively small space. Heating, cooking, lighting, and water heating are all by gas, and particulars and prices of all appliances are clearly marked.

The well-equipped kitchen in the Southampton "all-gas" house,

Showing multi-point water heater on left, built-in refrigerator, sink water heater, gas copper and iron, and all-enamelled cooker.

An average of 1000 people per week have visited the house during the six weeks it has been open for inspection, and very satisfactory business is being done.

The Gas Company are contemplating further all-gas houses in the near future.

The Treatment and Partial Distillation of Tar by Hot Crude Gases*

By Alfred L. Holton, M.Inst.Gas E. (Chief Engineer, Manchester Corporation Gas Department.)

There is no occasion in these days to stress the vital necessity of obtaining the maximum prices for the various bye-products of the Gas Industry. It is equally important that the costs incurred in the preparation and handling of such products should be reduced to a minimum. The present communication will deal solely with one of those bye-products—viz., tar.

Messrs. W. J. Chadder and H. M. Spiers in their paper on "Some Problems and Suggestions Relating to Coal Tar" have pointed out that an increase of 1d. per gallon in the selling price of tar is equivalent to just under 1d. per 1000 c.ft. of gas; and the object of the present paper is to emphasize the economies that can be effected by utilizing the sensible heat of hot crude gases for the treatment and partial distillation of tar.

Patents have been taken out from time to time for the distillation of coal tar by utilizing the sensible heat of the hot crude gas, notably by the Barrett Company, of U.S.A., using auxiliary apparatus attached to retort house fittings, while the patent of Cooke (of which Messrs. W. C. Holmes & Co., Ltd., are the licensees) uses the existing fittings in the usual gas-works practice—*i.e.*, hydraulic main, Congdon pipe, or collecting main.

The circulation of tar in carbonizing practice is not, of course, uncommon, but the treatment and distillation of tar with the deliberate intention of producing road tar, &c., by circulating the crude tar in the collecting mains is of comparatively recent date, and is the essence of the patent cited. The operation of the process is necessarily limited to those parts of the apparatus in which the temperature is above the dew point of the lighter oils in the crude gas.

In preliminary discussions on the question of the circulation of tar it became apparent that the principle was capable of wider application. Hot gases, other than crude coal gas from vertical retorts, might be used—*e.g.*, producer gas, water gas, &c. Hence experiments were initiated at the Bradford Road Works of the Manchester Corporation Gas Department utilizing the hot Trefois producer gas, and as a result of those experiments the Cooke-Holton patent was taken out.

The application of the process to vertical retort tar practice was studied in experiments at the Rochdale Road Works, and, finally, a more detailed series of experiments were carried out at Partington Works.

A description of the above processes, together with a statement of the results obtained, is given under the following headings:

Experiments based on Cooke's patent, together with subsequent experiments based on the Cooke-Holton patent, &c.
Some factors governing the process.
The economics of the process and the effect on the Gas Industry.

A short description of experiments carried out on the Still's tar cracking plant is also given.

APPLICATION OF PROCESS TO PRODUCER GAS PRACTICE AT BRADFORD ROAD WORKS.

The first experiments for the production of road tar were made in January, 1932. The preliminary difficulties were overcome at a very early date, and the final lay-out as shown in fig. 1 was adopted.

Alterations that have been made to the original lay-out of the Trefois plant are the adoption of a second vertical main up which the hot gases pass; and instead of three water sprays in the gas downflow pipe, a tar spray was fixed at the top of the upward flow pipe, the gas and tar flows being counter current. A tubular condenser replaced a board filled scrubber for the purpose of collecting the light oils and creosote.

It will be noted that the apparatus consists of two tar wells ("A" and "B"); the tanks are provided with steam coils, and connected to a pumping system, giving delivery either to the spray nozzles (fig. 5c) at the top of the vertical upflow main, or to the road tar sales tank.

The crude tar is delivered into tank "A," and steam is admitted to the coils. The warm tar is then delivered to the spray system, the tar outlet from the spray column flowing into tank "B." When the whole of the tar has been passed from tank "A" to tank "B" the cycle is reversed, the tar being pumped from tank "B" to the spray and then received back into tank "A." This cycle usually gives road tars in the range of British Standard Specification for Road Tar No. 1; a third cycle giving tar in the range of road tar No. 2. Thus the cycle can be repeated to obtain tars of very high viscosity and even soft pitch.

The distillate passes forward with the gas stream, the lighter products being retained in the gas, thus increasing the calorific value of the producer gas by 40-50 B.Th.U. per c.ft. The remaining oils are condensed in condenser "C," and collected in tank "D." Although only one tank is shown in fig. 1, the prepared tar is pumped into separate storage tanks at varying viscosities. The usual practice at the Bradford Road Works is to stock a tar of fairly high viscosity, and also a tar of from 6 to 10 secs. viscosity. With a proportionate mixing of the two tars in a suitable mixing tank, deliveries can be made to any required viscosity.

Working Details of Seven Days' Trial Run on Trefois Plant.

GAS.

Producer gas made			6,328,000 c.ft.
Temperature of gas entering tar spraying column:			
Minimum.	Maximum.	Average.	
238° C.	280° C.	253° C.	
Calorific value of gas, after tar circulating system			150 B.Th.U.
Increase in the calorific value of the gas (average)			35 "
Temperature of gas leaving condenser (average)			34° C.

TAR.

Temperature of tar leaving column:			
Minimum.	Maximum.	Average.	
93° C.	140° C.	122° C.	
Average temperature of crude tar to tank			21° C.
Specific gravity of crude tar at 15·5° C.			1·100
Average viscosity of road tar produced at 30° C. (B.R.T.A. Modified Redwood)			50 secs.
Specific gravity of road tar at 15·5° C.			1·156

OIL.

Specific gravity	0·996
Water content, % by weight	0·6
Tar acids, %	23·5

Standard Distillation (Flask).

° C.	%	° C.	%
172	Drop	250	79
180	3	260	82
190	6	270	84
200	14	280	86
210	35	290	89
220	57	300	92
230	64	310	94
240	73	320	96

BALANCE OF QUANTITIES.

—	Tons.	Cwts.
Crude tar delivered to plant	95	10
Road tar, 50 viscosity	80	6
Creosote oil	10	1
Loss due to water content of crude tar, 2·4%	2	7
Balance accounted for by increase in calorific value of gas (35 B.Th.U. × 6,328,000 c.ft.) and loss on process, 2·9%	2	16
	95	10

The plant has been in operation for eighteen months. It is easy of control, and no difficulty has been experienced in complying with all specifications for road tar. Very little labour is required, the operation being one mainly of pump control, which is performed by the Trefois plant at-

* A paper before the Manchester District Association of Gas Engineers, Oct. 27, 1933.

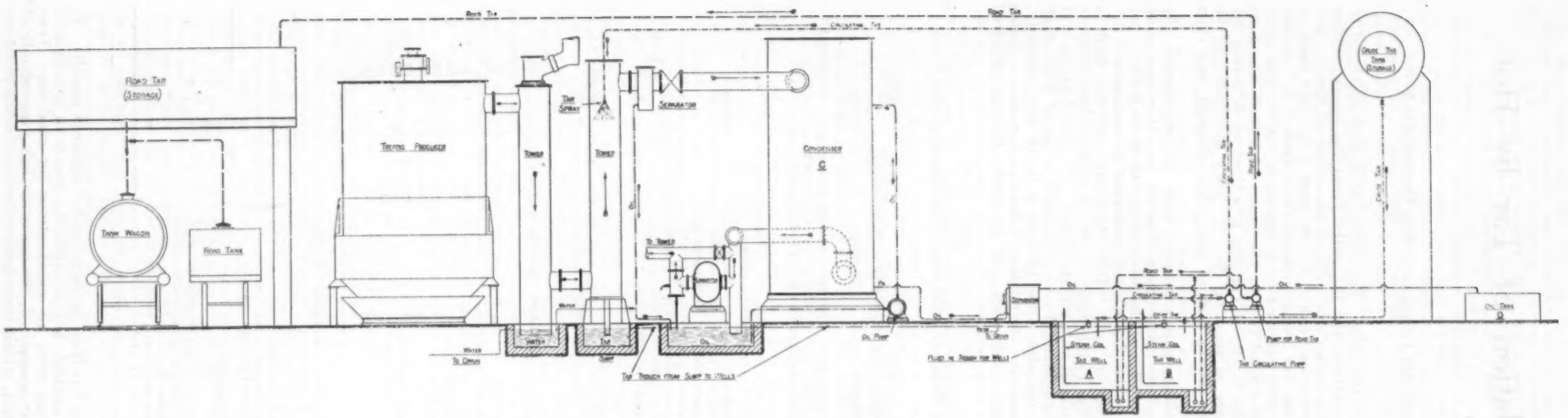


FIG. 1.—PRODUCER GAS FLOW DIAGRAM FOR COOKE-HOLTON ROAD TAR PLANT.

tendant, so that no extra cost is incurred except for mixing and loading.

APPLICATION OF THE PROCESS TO THE VERTICAL RETORT INSTALLATION AT THE ROCHDALE ROAD WORKS.

A bed of vertical retorts was chosen for the initial experiments at Rochdale Road Works, where the entire gas production is from an early type of Glover-West setting. It was anticipated, therefore, that any success attendant upon the preliminary trials could easily be repeated on more modern settings working at higher temperatures.

The settings at Rochdale Road Works consist of beds of eight retorts each with a nominal throughput of 2½ tons of coal per day, and steaming is carried out to produce a gas of 450 B.Th.U. per c.ft. Fig. 2A gives the approximate dimensions of the collecting main and offtake pipes, from which it will be observed that the cross-sectional area and consequent radiating surface are considerably above those of the modern type of plant. The usual practice is for the mains to be worked with a constant liquor supply, the mains being " run-off " or flushed once every 24 hours; but it was necessary to work the main " dry " for the purpose of tar treatment, and the connections were altered accordingly. The first test was carried out without any alterations to the setting, using the most convenient apparatus available on the Works.

The general arrangement for the experiment is shown in fig. 2B and consisted of (1) storage tank, (2) circulating pump, (3) tar spray, and (4) tar return pipe. Some measure of success was obtained with this layout, but it was evident that the large surface of the collecting main was robbing the tar circulating system of much valuable heat. The fall on the bottom of the main was so small as to cause trouble, the tar flow being sluggish. The first test was brought to an end by the tar thickening on the bottom of the main and ultimately blocking the outlet pipe, thus allowing tar to flow over the weir valve and down the gas main.

The conditions prevailing during the test are given below:

Temperature in gas main at " G^1 "	99°–121° C.
Temperature in gas main at " G^2 "	143°–149° C.
Temperature of tar at " T "	49°– 60° C.
Tar in circulation	300 gallons
Rate of circulation	200 gallons per hour
Tar after 43 hours' circulation—	
Water, 1%; oils at 200° C., 2·5%.	

Before proceeding with further experiments it was decided to insulate the collecting main as far as possible. The sides, top, and ends of the main were lagged with 2 in. of insulating material. The off-take pipes and tar storage tank were also insulated with a thin covering. A V-shaped trough was constructed of ⅛ in. M.S. plate and inserted in the collecting main with a pronounced fall to the tar outlet end, thus serving the double purpose of accelerating the tar flow and reducing the active area of the main. When these alterations had been completed, a further series of tests took place, and the results obtained were more satisfactory with the increased and steadier temperatures available. Test runs were then undertaken with a view to ascertaining the most efficient form of spray nozzle, speed of circulation, &c. A typical test run is given below:

Temperature at " G^1 "	121°–171° C.
Temperature at " G^2 "	171°–193° C.
Temperature at " T "	60°– 71° C.
Tar in circulation	300 gallons
Rate of circulation	200 gallons per hour
Shape of nozzle	⅜ in. fish tail

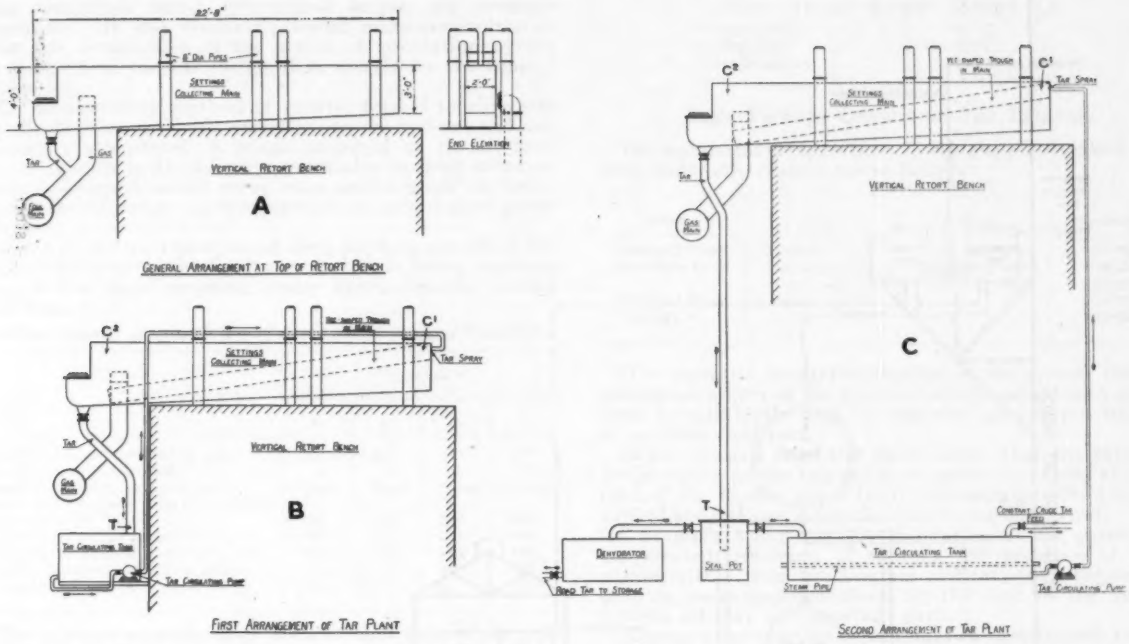
Tar analysis after 48 hours' circulation:

Water, 1·4%; oils 200° C., 1·5%; sp.gr., 1·145.
Viscosity, 15 secs. (dehydrated). B.R.T.A. Modified Redwood.

Very little trouble was experienced in working the process, except when the failure of a retort mounting caused admission of air and intense local heating. This defect resulted in the production of a pitchy deposit and a thin cracked tar which did not answer readily to the treatment; but it must be borne in mind that the retorts were of old design and at the end of their useful life.

With the experience gained from a series of satisfactory test runs, a more ambitious layout of the experimental plant was undertaken, and the final arrangement is shown in fig. 2C.

Owing to the increased quantity of tar in circulation, it was necessary to accommodate the storage tank, pump, &c., on the retort house floor, a distance of 32 ft. below the collecting main. The spray nozzle, found most satisfactory from the previous tests, was utilized, and took the form of



FIGS. 2A, 2B, 2C.—EXPERIMENTAL LAYOUTS OF TAR CIRCULATING PLANT ROCHDALE ROAD WORKS, MANCHESTER.

a ¾ in. diameter pipe slightly fish-tailed and curved upwards. A steam heated dryer was provided in case it should be necessary further to de-hydrate the tar produced.

Despite the heat losses consequent upon the long travel of the tar to and from the collecting main, very satisfactory results were obtained.

Two distinct methods of circulation were tried—viz.:

(*a*) Circulating the tar without addition—*i.e.*, in batches—until it complied with the required British Standard Specification.

(*b*) The continuous addition of tar during circulation, and the daily removal to a separate storage tank of a predetermined quantity of tar.

It was considered that the latter method would most readily suit the conditions normally found on gas-works. A typical test run using method (*a*) is given below:

	Average °C.
Temperature at point "G¹"	99
Temperature at point "G²"	160
Temperature at point "T"	79
Tar in circulation	1000 gallons
Rate of circulation	600 gallons per hour
Tar after 13 days' circulation—	
Water, 0·5%. Viscosity 50 seconds (B.R.T.A. Modified Redwood)	

It will be observed that the increased rate of circulation lowers the temperature at the admission end of the main, but maintains a higher temperature in the tar storage. It was found that prolonged circulation steadily increased the viscosity until pumping was no longer practicable.

With regard to the second method (*b*), it was found that in order to conform to the British Standard Specifications, the maximum quantity of tar which could be treated on the particular setting was 75 gallons per day. A run using 100 gallons of tar daily resulted in a continuous fall in viscosity.

The following results were obtained by the daily additions of 50 and 75 gallons of crude tar respectively and the removal of corresponding quantities of prepared tar. The

Tar Analyses.

—	1 50 Gallons of Crude Tar Added per Day.	2 75 Gallons of Crude Tar Added per Day.	Original Crude Tar.
Water	0·5%	0·3%	8·8%
Oils—			
200° C.	0·4%	0·4%	6·4%
200-270° C.	11·0%	13·1%	21·8%
270-300° C.	6·4	7·1	8·6
Phenols	3·5	3·7	8·9
Naphthalene	Trace	Trace	Trace
Free carbon	9·2	8·8	3·6
Specific gravity	1·161	1·154	1·089
Viscosity at 25° C. (Hutchinson)	50 secs.	35 secs.	..

temperatures were similar to those given in the foregoing test run using method (*a*), the quantity of tar and rate of circulation being the same.

Under method (*b*), the plant continued to run satisfactorily for twelve months, when it was dismantled for the reconstruction of the retort bench, the experiment being continued in greater detail at Partington Works.

The labour involved is slight, being that required to remove to storage the daily quota of prepared tar. The only supervision needed is an occasional glance at the seal-pot to see that the tar flow is regular.

APPLICATION OF THE PROCESS TO THE VERTICAL RETORT INSTALLATION AT THE PARTINGTON WORKS.

A bed of eight vertical retorts of the standard Glover-West type 40 in. by 10 in. by 25 ft., each retort having an average throughput of 85 cwt. per day, was fitted for the treatment of tar by the Cooke process. In order to retain the maximum amount of heat, the ascension pipes, collecting main, and all circulating pipes were covered with an insulating lagging of "Kisol" asbestos and magnesia. The collecting main was drilled to take four sprays, which were inclined to an angle of 60°, and so fixed that the tar spray was delivered in the opposite direction to the gas stream from each pair of ascension pipes. The usual liquor drain cock was disconnected, and a 4-in. pipe connected to the tar circulating tank by means of a seal box fitted with a V notch for the purpose of measuring the rate of circulation (see fig. 3).

Tar is pumped from the main storage tank into a measuring supply tank, which in turn feeds the main circulating tank. The main circulating tank has a capacity of 1000 gallons, and the tar is circulated through the sprays at a pressure of 30 to 40 lbs. per sq. in., for varying periods of six to eight hours, road tars being obtained of viscosities varying according to the temperature of the gas in the collecting main, and to variations in rate of flow, &c. In general practice, 600 gallons of tar are treated per eight hours, and road tars complying with Nos. 1 and 2 British Standard Specifications are produced.

The tar spray finally adopted is shown in fig. 5B, type "B." This form allows for clearing the spray by opening the port without the trouble of removing it.

Reliable pumping arrangements are necessary for the control and efficient working of the process.

The oils from the distillation of the tar in the hydraulic main have not been separately collected, for until the process is extended to the whole of the retort installation they are mixed with the other tar condensates. They would, however, approximate to those found in the application of the process to the Trefois producer.

The process was further developed to include the manufacture of pitch. Two Hird stills, heated by producer gas, complete with condensers, collecting tank, and pitch coolers were erected by Messrs. W. C. Holmes & Co., Ltd. This

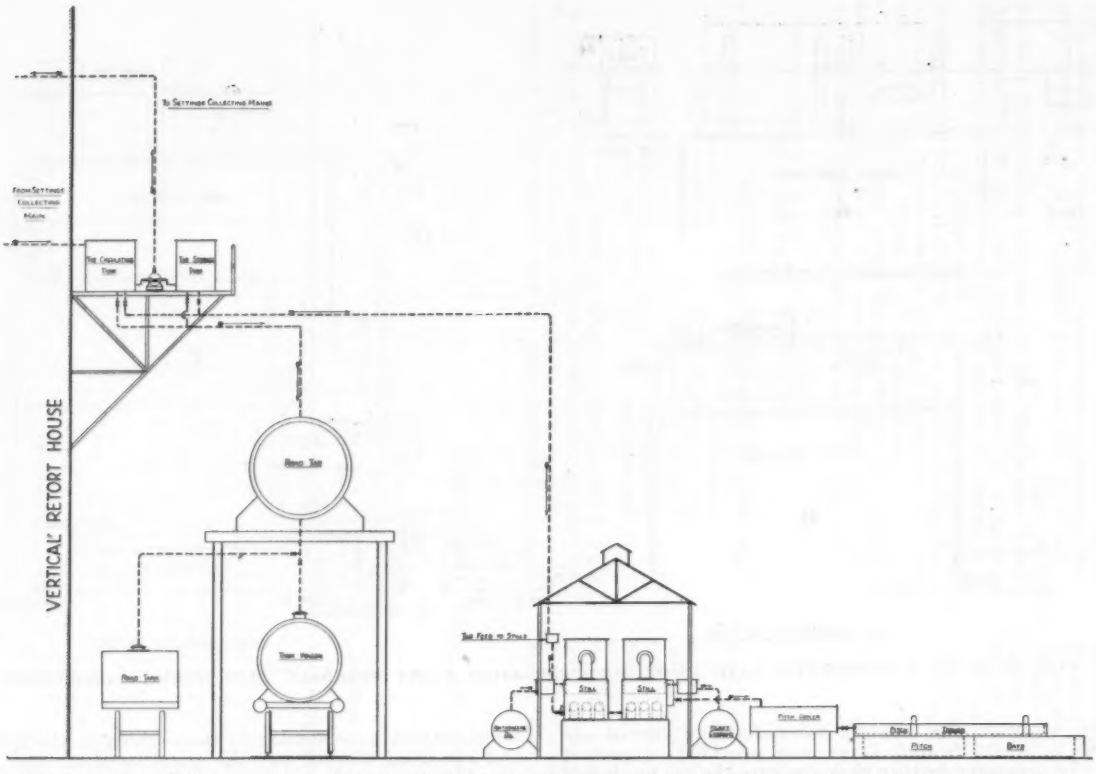


FIG. 3.—EXPERIMENTAL PLANT (COOKE PROCESS)—7 TONS PER DAY. PARTINGTON GAS-WORKS, MANCHESTER.

plant is capable of treating the equivalent of 7 tons of crude tar per day. Hot tar from the road tar tank was passed in regulated and continuous flow through the stills, and the products separated in the usual manner, no difficulties of any moment being encountered.

For some five months previous to the test run period road tar only had been made, and some typical analyses are given in the next column.

The complete distillation system having been installed, it was decided to make a series of test runs. The tar was circulated on the "batch" system, any variation in the quality of the prepared tar being effected either by changing the quantity of tar circulated, or by the period of circulation, or both. The choice of conditions was some-

Tests of Road Tar.

Prepared from different Crude Tars.

Specific gravity at 60° F. . . .	1·153	1·155	1·159
Viscosity (Hutchinson at 25° C.)	26	53	123
Water, % by weight	*Nil*	*Nil*	0·1
Tar acids, % by volume	3·2	4·1	2·8
Naphthalene, % by weight . . .	*Nil*	Traces	*Nil*
Free carbon, % ,, . . .	12·4	10·8	12·2
Distillation—			
To 200° C., % by weight . . .	0·8	0·7	*Nil*
200-270° C., % ,, . . .	10·5	12·5	9·3
270-300° C., % ,, . . .	5·8	4·7	5·6

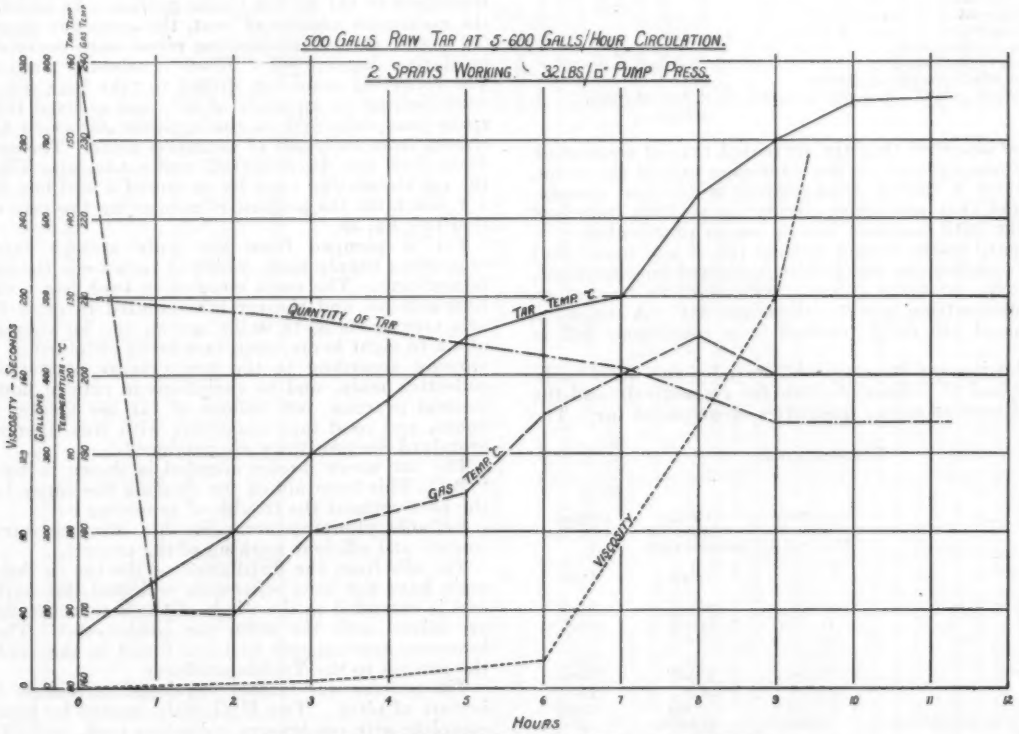


FIG. 4.—TAR DEHYDRATION TEST, 2/8/33, PARTINGTON.

what empirical, being determined largely by previous experience. It was ultimately found more convenient to judge the termination of the period of circulation by the temperature of the tar rather than merely by the time of circulation.

The temperature method of control tended to eliminate the effects of unavoidable variations in the system, and any temporary stoppages. A graph prepared on similar lines to those shown in fig. 4 for the particular working arrangements concerned would serve as a useful guide in determining the necessary tar temperature for any desired grade of tar.

Below is given an analysis of some working details of the circulating system, the figures in each case being averages from a few days' working under approximately similar conditions:

Working Details of Circulating System under Various Conditions

	Samples.			
	B.	C.	D.	E.
Quantity of crude tar treated, gall.	632	395	400	400
Period of circulation, hours	6	6	6	7½
Rate of circulation, gall per hour	8/900	8/900	8/900	8/900
Temperature of gas at inlet to collecting main, average ° C.	257	259	258	230
Temperature of gas at end of run, ° C.	186	203	214	200
Temperature of tar at end of run, ° C.	128	145	163	165
Quantity of tar at end of run, gall.	513	333	320	280
% of prepared tar on original tar	81·2	84·3	80	70

The table on opposite page gives tests of some of the prepared tars made.

The tars so prepared were transferred to the storage tank (fig. 3), being kept warm by a closed steam coil. From this tank the tar is passed to the Hird still. The results of the distillation of certain grades of tar, the results of the examination of the distillates from the stills, and an analysis of an average sample of the pitch produced during one week's run of the stills are given below:

Distillation of Road Tar. (Hird Stills).

Samples.	Volume of Tar. Gallons.	Weight, Tons.	Viscosity. *	Distillate. Total Gall.	Distillate. Per 1 Ton. Gall.	Distillate. % Volume.	Distillate. Sp. Gr.	Pitch Fusing Point. ° C.
A.	7290	37·33	10	2693	72·1	36·9	1·041	84
C.	3500	17·96	40	1252	69·7	35·8	1·060	76
D.	3242	16·86	260	893	53·0	27·5	1·063	81

NOTE.—* Tested by Hutchinson, Junior, at 25° C.

Test of Distillate from Prepared Tars (Hird Still).

—	Samples. A.	C.	D.
Specific gravity at 60° F.	1·041	1·061	1·063
Distillation on dehydrated oil—			
Up to 200° C., % by volume	1	..	½
at 210 ,, ,,	2	..	1
220 ,, ,,	4½	1	1½
230 ,, ,,	9	5	2
240 ,, ,,	15½	10	6
250 ,, ,,	22	15½	11
260 ,, ,,	29	20½	14
270 ,, ,,	34	25½	17
280 ,, ,,	41	32½	22½
290 ,, ,,	46	39	29½
300 ,, ,,	53	44	35½
310 ,, ,,	57½	52	41½
315 ,, ,,	62	56	..
320 ,, ,,	63½	60	50½
330 ,, ,,	67½	65½	58½
340 ,, ,,	72½	71½	65½
350 ,, ,,	77½	73½	71½
360 ,, ,,	83	77½	79½
Tar acids in distillate to 315° C. (calculated on dehydrated oil % by volume)	15	..	..

Pitch—Average Sample (Sample A.)

Twisting point	62° C.
Fusing point	84° C.
Volatile matter	78·5% by weight
Ash	0·4% by weight

Some Factors Governing the Process.

The significant temperatures in the gas plants which have been under observation are as follows:

Works.	Gas.	Position.	Temperature. °C.
Bradford Road	Trefois	Down take pipe	238–280
Rochdale Road	Vertical (GW)	Collecting main	135–185
,, ,,	,, (GW)	,, ,,	190–340
Bradford Road	,, (WD)	,, ,,	160–215
Partington	,, (GW)	,, ,,	235–320

It is essential in any application of the process that the gas temperatures at the point of initial contact with the tar shall be sufficiently high to eliminate all oils not required in specified road tars.

It will be seen from the above tables that the ranges of temperatures of the hot gases are somewhat wide, although that of the Trefois gas is fairly constant, but the temperature of the hot gas is not the only factor concerned. Thus, for example, volume of gas in relation to the quantity of tar treated, efficiency of contact, the presence of water vapour either from the original raw tar, from the retorts, &c., or undecomposed steam in the case of the vertical retorts, all play an important part.

Among other factors which may be concerned are the following:

(*a*) In addition to the normal cooling of the hot crude gases in the collecting mains, &c., there will be further condensation by the action of the circulated tar introduced through the sprays, while at the same time there is some distillation and evaporation from the tar itself.

(*b*) It is possible also that there may be molecular changes (*e.g.*, condensation in the chemical sense).

On the Trefois plant at Bradford Road Works and on the Glover-West plant at Partington Works there has not been the slightest difficulty in producing No. 3 road tar or even soft pitch.

The horizontal retort bench at Bradford Road Works was built (deliberately) with the hydraulic main well above the bench, and consequently the ascension pipes are decidedly longer than usual. When working on 24 hour-charges, the temperature of the gas entering the hydraulic main is from 50° C. as a minimum, to 115° C. as a maximum, the latter figure being reached two hours after charging. These figures represent the worst possible conditions from the standpoint of road tar manufacture, and under such conditions the process might not be successful. But if the retorts were charged, say, every hour (in turn), and the ascension pipes were lagged, it is possible that satisfactory conditions could be maintained; or, alternatively, the Congdon pipe system would in all probability satisfy the necessary conditions. However, in small works or where the foregoing arrangement would not be possible, the process covered by patents taken out by Mr. E. A. Davies, the Manager of Bradford Road Works, and described later, would afford an alternative.

It has been commonly considered that vertical retort tar was unsuitable for the production of road tar, but no difficulty has been experienced in producing road tars from either Rochdale Road Works or Partington Works tars which meet, in all particulars, the British Standard Road Tar Specifications.

It may be recalled that in a previous paper on the Trefois producer [see "Gas Journal" for Oct. 15, 1930, p. 151], it was stated that there was a deposit of 0·12% dust (dry) in the early part of the cooling system. When road tar is being made this dust goes into the product, but the effect on the road tar is insignificant, since the dust would raise

Tests of Prepared or Road Tar (Partington).

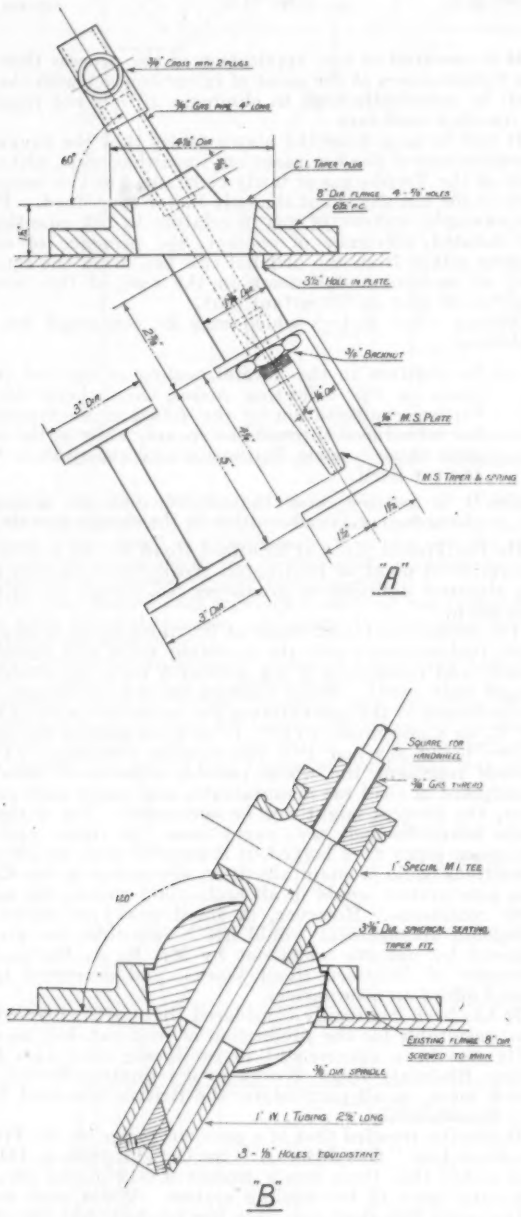
Sample.	Tar.	Sp.Gr.	Viscosity.	Water % by Weight.	Distillation % by Weight (on De-Hydrated Tar). Up to 200° C.	200 270° C.	270/300° C.	300° C. to Pitch.	Pitch.	Tar Acids in Fraction to 270° C. % by Volume.	Free Carbon in Tar % Weight.
—	Crude	1·1036	..	3·92	1·8	23·4	4·3	19·5	49·2	7·45	3·5
A	Prepared or road tar	1·147	10 (*b*)	0·13	0·2	11·4	6·9	17·8	61·8	4·2	..
B	,,	1·148	18½ (*a*)	0·4	0·4	12·6	6·4	14·7	64·3	3·9	9·3
C	,,	1·153	43 (*b*)	0·26	0·25	14·0	4·8	..	..	3·1	11·9
D	,,	1·160	260 (*a*)	0·13	0·1	6·1	6·65	13·65	71·7	2·2	..
E	,,	1·165	210 (*c*)	0·20	0·1	6·0	6·2	13·0	73·8	1·8	11·4

NOTES.—(*a*) Tested by Hutchinson, Junior, at 25° C.
(*b*) ,, ,, Redwood at 30° C. } (B.R.T.A., Modified Redwood).
(*c*) ,, ,, ,, ,, 35° C. }

the "free carbon" content by about 0·15% only. It might well be argued that this addition would be advantageous rather than otherwise, since the carbon is in a very finely divided state, and filled tars are in demand.

Types of sprays in use are shown in sketches figs. 5A, 5B, and 5C. In order to assist in preventing blockage, arrangements should be made for the filtration, through wire sieves, of the tar before and during circulation.

It is of interest to note that the hydraulic mains themselves are free from deposits. The heavy tarry deposits which are commonly found in the foul mains of retort houses, and for the removal of which special arrangements are made, are no longer present. Ammonium chloride may be the nucleus round which some tar clusters, and



Figs. 5A and 5B.—Details of Sprays Used on Tar Dehydration Plant.

should be removed by steam washing, or by filtration as described above. The deposits themselves may be washed with hot water for the removal and recovery of the ammonium chloride. There should also be provision for clearing the sprays themselves from time to time. The spray shown in sketch 5B gives such facilities. Any procedure for eliminating chlorides from tar would be applicable.

Where comparatively large bulks of tar and high temperatures are concerned, there is no need for atomizing, but probably finer sprays would be needed with smaller quantities of tar and comparatively low gas temperatures.

Since the primary distillation of the tar in the collecting mains of the Glover-West plant takes place in an atmosphere of steam and free ammonia, the minimum of corrosion will take place—in contrast with the amount of corrosion which takes place in a tar still in which a similar stage of distillation is reached. More efficient working could be attained by pre-heating the fresh supplies of raw tar.

Possibly the next advance may be in the direction of fractional condensation of the crude gases leaving the mains. Here electrical precipitation would materially assist by removing the tar fog, and so ensuring cleaner oils in the condensing plant. In the early days, there was much laxity in the preparation of refined tar, and this, together with the absence of any Standard Specification, gave to road tar a bad name. The British Road Tar Association's Specifications are to be welcomed as giving a fixed basis on which to work, but even they should not be considered as final. There is need for still further research—which indeed is being carried out—and among other factors which need consideration are the "wetting" and "binding" capacities of the ideal road-treating materials.

THE EFFECT OF THE NEW PROCESS IF ADOPTED BY THE GAS INDUSTRY.

In considering the proposals as they affect the Gas Industry, many questions naturally present themselves. One of the main issues would be the policy to be adopted in the disposal of the tar. Would the gas-works distil completely to the primary products or confine themselves to the preparation of road tar? The process outlined can do both, and the flexibility of the plant is one of its many advantages. Whichever course is adopted, however, it is vitally important that the products should conform strictly to Standard Specifications. This desideratum is easily attained by the larger works, for they have the necessary trained staff at their disposal. The smaller works, how-

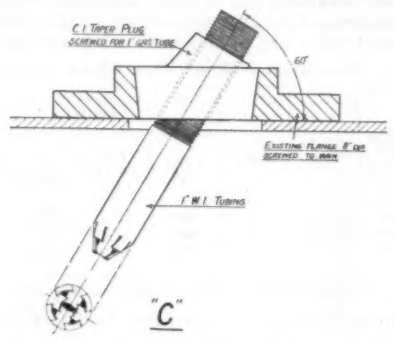


Fig. 5C.—Details of Sprays Used on Tar Dehydration Plant.

[For A and B sections see opposite column.]

ever, are not so favourably placed, and it would be an advantage for them to combine in such a way that the services of a trained technician were available, who would direct and supervise the process by regular and frequent visits. Such control could be organized along with any combined marketing arrangements.

The experiments that have already been described, together with the results tabulated, serve to illustrate that in every gas-works there exist potentialities which can be utilized to increase the revenue derived from the sale of tar, for the benefit of the individual undertaking.

The savings that can be effected by the adoption of the process for the treatment of crude tar may be summarized as follows:

(*a*) The elimination of carriage costs from the gas-works to the tar distiller's works, together with a reduction, in the case of a large number of works, in the cost of carriage of the road tar to the purchaser.
(*b*) Reduction in labour costs, due to the fact that the process is incorporated into gas manufacturing operations.
(*c*) Reduction in the fuel costs due to the utilization of the sensible heat in the hot crude gases.
(*d*) Less water required for condensing purposes in producer gas practice, since no water is used on the first part of the spraying system. It will be appreciated that this also applies to water gas manufacture, where the necessary sensible heat is available.
(*e*) Reduction in capital charges, since a portion of the plant is already installed at every gas-works.

It is difficult to prepare a financial statement giving an estimate of the additional revenue that would accrue to a

typical gas undertaking, since conditions vary considerably; but the information presented will enable estimates to be prepared by those undertakings interested in the process.

It may be fairly claimed, however, that on a conservative basis working costs will be reduced by approximately 5s. per ton of crude tar treated to the usual primary products, and for the production of road tar a much higher figure—probably 10s. per ton—since there would only be the cost of the storage tanks and pumping charges.

Having considered the effect of the process from the manufacturing side, consideration must be given to the marketing of the products. The usual course adopted by gas undertakings is to dispose of the tar in its crude state, usually under contract—co-operative or otherwise—for a clearly defined period. If the process were adopted, road tar and primary products would be available for disposal in place of crude tar.

In small undertakings situated in the country it is quite possible that only road tar need be produced, since there would be a constant demand for this product in the immediate vicinity during the road surfacing season, and additional storage accommodation for road or crude tar during the winter months would meet their particular case. Thus, instead of a country gas-works being geographically at a disadvantage in having to bear heavy carriage on the tar to the distiller's works, its situation would now be turned into a definite asset. In the larger undertakings it would probably be an advantage to be able to distil to the primary products in addition to producing road tar, or, alternatively, the road tar together with the recovered oils might be sent to the usual tar distillers for subsequent treatment. The products do not differ from those obtained by the usual methods of distillation, but an advantage may be claimed for the process described, in that satisfactory road tars may be produced even from most vertical retort tars.

In the very early days of the process, a length of road subject to heavy traffic was treated solely with road tar prepared as described, and the result has proved very satisfactory. The process has been favourably reported upon by both tar chemists and users.

Every precaution has been taken to ensure the marketing of products conforming to the required specifications. The process has been in continuous operation for over five years at works other than Manchester, with every success. During the past thirteen months 700,000 gallons of road tar have been delivered from the Manchester Undertaking.

The following channels are open for the disposal of the products:

(1) The gas undertakings may sell direct.

(2) The gas undertakings may sell through an agent, on the usual basis.

(3) They may participate in one of the co-operative schemes at present in existence, or form a co-operative scheme within the Gas Industry.

It is probable that some undertakings would decide to sell the products direct, or through an agent. Alternatively, there is much to be said for collective effort, one of the main advantages being that wasteful competition is avoided. It would appear, however, that some modification of the existing co-operative schemes would be necessary, since the crude tar would already have been treated at the gas-works. In other words, the main function of the co-operative scheme would be that of selling the final products—*i.e.*, road tar and pitch—together with the sale or treatment of the recovered crude oils.

A large field is open for our products, and owing to the activities of the British Road Tar Association, prepared tar is becoming the product *par excellence* for road surfacing and building. England and Wales have approximately 160,000 miles of public roads. A figure of 2000 gallons of prepared tar per mile of road can be taken as an average for surfacing, but this figure naturally varies according to the width of the road. Of the crude tar produced by all the gas-works and coke ovens in this country, 60% is converted into road tar. Gas-works are situate in every part of the country.

To name such facts forces upon our notice the opportunities which are at hand for enhancing the revenue of gas undertakings, and also for using a British product for British roads.

STILL'S TAR CRACKING PROCESS.

While not coming within the scope of the main title of the paper, the present occasion is opportune for calling attention to experiments that have been made on the vertical retort tar produced at Rochdale Road Works by the cracking process of the Firma Carl Still. These experiments were carried out in addition to those already recorded, with the object of enhancing the revenue obtained from tar. A general description of the process follows.

The heavy oil obtained by the condensation of the vapours from the previously treated tar is circulated by a high-pressure pump through a preheater, into the cracking coil and then through a reducing valve at the base of a column, where the pressure is released. The valve is mechanically operated to prevent fouling and constitutes an essential patent in the process. The vapours produced pass through the column, cold tar being introduced by gravity feed from an overhead tank into the circulating oil vapours. The lighter portions of the tar are distilled off, and pass up the column, the residue—*i.e.*, road tar or pitch—remaining at the bottom and being suitably withdrawn.

The vapours passing up the column consist of a mixture of the lighter portions of the tar, together with any cracked spirit from the previous cycle, uncracked tar vapours, vapourized heavy oil, and the gas produced in the cracking process. Any light vapours that may condense, and find their way into the residue at the bottom of the column, are ultimately removed by the passage of part of the hot vapours from the release valve through the residue. At the top of the column the heavy oil vapours and uncracked tar vapours are condensed, and the condensed oil finds its way back into the circulating oil tanks through a seal pot. The oil is then again pumped through the cracking coil, and the cycle repeated. The maximum temperature attained by the tar is approximately 600° C. and the pressure approximately 55 atmospheres. The lighter vapours (termed "Benzin"), together with the water vapours and gas, pass through the dephlegmator, where the desired degree of fractionation is accomplished. The vapours leaving the dephlegmator pass to the condenser and separator, the gas being withdrawn at this point.

If road tar is required, the temperatures of the column are adjusted as may be necessary (by altering the flow of tar), so that the heavy oil in the necessary quantity is deposited with the pitch. When pitch is being made, there is a surplus of heavy oil which gradually accumulates either in the circulating oil tanks or in separate receivers. The excess heavy oil, if separately collected, contains a certain proportion of benzin, and before withdrawal is circulated without the addition of tar, the tar connection being closed during this run. The gas leaves the condenser at a slight pressure, which can be adjusted by means of the syphon at the outlet point.

Twelve tons of tar from Rochdale Road Works were submitted to treatment in the plant at Wolfsbank Coke Oven Works, Essen, and two representatives of the Manchester Corporation Gas Department were present during the trial run.

The following results were obtained:

Yield per Ton of Dry Tar.

Benzin	50·7 galls.
Benzin in gas	7·1 ,,
Heavy oil	46·1 ,,
Increase in circulating oil	8·8 ,,
Pitch	963 lbs.
Gas	1968 c.ft.

Tests of Products.

BENZIN.

°C.	72.	80.	100.	120.	150.	180.	200.
%	Drop point	3	6	11½	22	62	95

HEAVY OIL.

C.	236.	250.	300.	360.
%	Drop point	6	23	35

PITCH.

Softening point (K. and S.)	67° C.
Twist point (English)	52° C.

GAS.

	% by Volume.
CO_2	0·85
O_2	0·25
Heavy hydrocarbons	9·05
CO	1·6
CH_4, C_2H_6, &c.	72·45
H_2	9·25
N_2	6·55

Calorific value (determined) 1440 B.Th.U. per c.ft. (gross).

A FURTHER PROCESS FOR PRODUCING ROAD TAR, &c.

The method of producing road tar, &c., patented by Mr. Edward A. Davies—the Manager of the Bradford Road Works—(referred to in the text) is based on the passing of crude tar over heated surfaces without bringing the tar into contact with the heating medium employed. The medium utilized for heating those surfaces may be hot waste gases, producer gases, or steam.

A heating system is suitably housed, with connections to

the heating medium and condensing system. The distillates may be withdrawn by an exhauster. The arrangement and working of the collecting tanks is similar to the one used on the Trefois plant.

In conclusion, the Author wishes to acknowledge, with appreciation, the enthusiastic co-operation of the Managerial and Chemical Staffs at each of the Works where experiments forming the basis of this paper have been in operation.

Discussion.

At the commencement of the discussion, Mr. HOLTON expressed his thanks to the services of his staff who had made the necessary experiments and carried out a considerable portion of the work necessary to enable him to prepare the paper. At the present time, experiments were being carried out at the Bradford Road Gas-Works of the Manchester Corporation in regard to the distillation of the tar from the waste gases from the horizontal retort setting. The temperature was not sufficiently high in the hydraulic main to adopt the usual circulation. A long trough was used through which was passed the heat from the waste gases on their way to the chimney. The gas stream from the hydraulic main was passed over the tar, doing away with the exhauster referred to in the text of the paper. He had particularly wished to draw attention to this method of operation, because there were a number of small works where horizontal retorts were in use whereby the ordinary circulation could not be attained because of the temperature difficulty. The success of the process now in operation at the Bradford Road Works of the Manchester Corporation indicated that on all works there was the temperature and the facility for carrying out the distillation of the tar in the manner described in the paper.

The PRESIDENT said that Mr. Holton's paper exhibited two usual characteristics that they were now accustomed to look for in connection with any of Mr. Holton's work. The first was his personal desire to pass on any information, and the result of any useful practical work that he did, for the benefit of others, and the second was his desire to pay a very generous acknowledgment to the help that he received from his staff. He felt proud to be President of the Association at a time when Mr. Holton presented such a paper, because he was convinced that it would be of very great value to the Industry as a whole.

THE QUESTION OF UNIFORMITY.

Mr. C. S. SHAPLEY (Engineer and Manager, Leeds Gas Undertaking) contributed the following written communication to the discussion: Refined tar contains too high a percentage of tar acids, which acids are definitely detrimental. Large buyers whom I know specify "acids as low as possible," and are supplied with a quality containing less than 2%. Tar would be rejected by them if it contained 2½%. On the other hand, horizontal tar distilled by the same methods would contain too much naphthalene. The pitch test given in the paper is not satisfactory, and owing to the high volatile content, coupled with the high twisting point, would not be considered of good merchantable quality.

The B.S. Specification for refined tar represents the lowest limit of suitable tar for road purposes, and it is not satisfactory to just get within the limits allowed.

Bitumen has succeeded so far largely because of its uniformity. If individual gas-works are going to market a road tar made by straight distillation from their own particular crude, uniformity characteristic is practically out of the question.

It is only by the blending of tars, coupled with methods other than straight distillation to the required viscosity, that there is any hope of obtaining such a practical uniformity.

Col. W. M. CARR (Engineer and General Manager, Stretford Gas Undertaking) said that everyone would be agreed that Mr. Holton was to be congratulated upon the pioneer and experimental work which he had been so good as to embody in his paper. He appreciated that the work was still in its infancy, but it did appear unfortunate that Mr. Holton was not in a position to give any costs or any facts as to labour or fuel which might be required in connection with the process. By fuel was to be understood not only the fuel for the stills for primary distillation, after the preparation of the road tar, but also fuel used in other directions in the process. As an illustration, where a works was not recovering its waste heat in the boilers, in the last instance there was economy. Many gas engineers to-day had to obtain the maximum economy by recovery in the form of steam. Nowadays, they did not get very much for nothing, or, at any rate, if they were getting it for nothing they ought to have been saving it before.

He would like to refer to several technical points in the paper. Mr. Holton had pointed out the variable factors which affected the production of a tar of standard quality. It was those variable factors which appeared to be the great difficulty in the successful operation of the process described for the purpose of producing a tar of absolutely standard quality. A tar might be produced within the B.S. Specification, but they all knew to-day that the B.S. Specification was not sufficiently stringent for the average surveyor as a buyer of tar. The surveyor required a guarantee of a specific tar to be supplied within the B.S. Specification and which must be supplied without variation.

Mr. Holton had pointed out that the periods of circulation were from 6 to 8 hours. He would be very interested to learn what was the practice for synchronizing the circulation of the tar with the two variables—namely, the temperature and volume, of the gas leaving the retorts. He would also like to learn what arrangements Mr. Holton made to ensure a constant of the known rate of circulation from his tar pumps.

It was also stressed in the paper that the gas temperature, at the initial contact with the tar, should be sufficiently high to eliminate all oils not required in a specific road tar. It would appear to be a matter of great difficulty to ensure a definite constant gas temperature leaving the retorts under all the variable working conditions with which the average carbonizing plant had to cope.

A question he would like to raise *à propos* the application of the process at Bradford Road was what value did Mr. Holton place upon the loss of benzole which there must be from the tar, and which went forward to enrich the producer gas for heating the settings, because the value of a B.Th.U. as benzole, at the present time, as compared with the B.Th.U. unit of producer gas, from a marketable point of view, was very much greater. It was significant in regard to the process that, after all, up to the production of road tar and increasing the viscosity of the tar, the process was new. After that, of course, if one was going to work to products one had to follow the process of ordinary tar distillation.

It would be interesting to learn if figures were available of the amount of fuel that was used in the Hird still per ton of the heavier tar which was treated. It was possible that, having removed the light oils from the tar, and having produced a tar of heavy viscosity, which it was intended to treat for distillation, the quantity of fuel required might be more than was necessary, in the first instance, for treating crude tar in a primary still as was done in a normal method of distillation.

He would like to receive information respecting the free carbon content of the tar, and with reference to the amount of dust and ash that might be picked up from the gases, when working on producer gas, or, for that matter, though in a less measure probably, on water gas. Mr. Applebee, in a comment, had said that there was an infinitesimal increase in the free carbon in the prepared tar itself, but that infinitesimal increase in the free carbon might be accompanied by an increase of ash which would be detrimental when that ash eventually came to pitch. He did not wish, however, to stress that point. Nevertheless, let them not close their eyes to the fact that, if they could drive bitumen out of this country, and if they could sell the whole of their tar as road tar, it would not absorb 30% of the road tar which could be produced. Unfortunately, the figure to-day was that only about 12% of the total tar produced was used on the roads as road tar, so that it must be remembered that the bulk of the tar produced in this country must inevitably be distilled to products.

ARE THE CONCLUSIONS JUSTIFIED?

Frankly, he felt that Mr. Holton had very much more evidence to support the conclusions in his paper than he had put forward, otherwise he would not have made his conclusions and recommendations so definite. The absence of figures in the paper made it difficult to appreciate that those conclusions were justified. For example, first of all, there was the question of the elimination of carriage costs. He was sure Mr. Holton would forgive him attempting to construct an analysis of his conclusions. Much lower carriage was paid on crude tar than in the case of products. Throughout the country it had generally been the case that the tar distiller had placed his works at a point where he could ship the products. After all, the tar market was an international market. This country could not sell the whole of the tar it produced at home; in a country which was entirely dependent upon its coal. A great deal had to be sold abroad, and one of the principal markets for pitch was France. Therefore, many tar works were disposed at points where the products could be shipped at very low costs and put f.o.b.

Many works were situated so that pitch could be put on board ship at 1s. or under a ton. The same type of observation applied with regard to delivering oils for creosote distillation. So far as carriage was concerned, it was often very much cheaper to send the crude tar to such a works than it was to prepare the products in the gas-works and send the products to the port of shipment. Therefore, it did not seem likely that a general claim could be proved to be applicable to everybody on the basis of paragraph (*a*) of the five claims which were set out in the paper.

LABOUR AND FUEL COSTS.

A point had been made with regard to the reduction in labour costs. It was very difficult to conceive where the reduction of labour would occur if there was working to products. He appreciated that there would probably be some saving in the manual labour. There would not be a great deal of saving in pumping, because with the continuous circulation the amount of mechanical labour and steam involved in the circulation of the tar through the system described must be obviously much greater than in an ordinary system of tar distillation.

There was another point which he did not want to stress, but it was true at the moment though it might not be in existence for long. The rates of wages paid in a gas-works were higher than those paid in an average tar distillery. It was none the less an important factor, and the difference was so great as to be substantial in the total costs. It would be useful to know where the saving in labour came in.

Item (*c*) in the paper dealt with the reduction in fuel costs due to the utilization of the sensible heat in the hot crude gases. As Chairman of a co-operative scheme he had gone into very careful costing. Coal had been weighed at one of the works used for primary distillation—namely, on the stills. The coal used on the stills in that particular works was only 26% of the total coal used. In other words, no less than 74% of the total coal used was used for steam raising and so on, having regard to the large amount of steam that was required in the rectification of tar acids, benzole, and various processes. He was speak-

ing from knowledge, and from figures of tar distillation works under a co-operative scheme.

The average cost of coal used over the whole of the works amounted to 3s. 2d. per ton of crude tar treated, including the whole of the processes right to the final rectified products. Assuming that one-third of this was utilized on the stills—it was not actually one-third, but something under that proportion—he could safely assert that the cost of fuel for distillation by still on the present value of coal did not exceed 1s. So there was not an enormous saving to be made per ton of tar on the fuel. Having regard to the limited amount of road tar that could be sold the saving in fuel could not be very great. He desired to stress this point, because sometimes one might forsake the substance in going after the shadow.

Item (*d*) in the paper stated that less water was required for condensing purposes in producer gas practice, since no water was used on the first part of the spraying system. It would be appreciated that this also applied to water gas manufacture, where the necessary sensible heat was available. It would be of advantage if Mr. Holton would put a commercial value on that claim of so much per ton treated. Personally, he would regard it as something infinitesimal. In any case, he would like to know how it was contended that less water was actually used, and upon what extent that contention was based, because, conceivably more water might be necessary. The oils were carried forward in suspension in the gas, and the question of condensation was not entirely a matter of temperature alone but also of molecular construction of the gases that were to be condensed. It was difficult to appreciate that a saving which was reasonably measurable could be claimed on that basis.

Capital Charges.

With regard to the question of the reduction of capital charges, he appreciated that the cost of installing a circulating system of pumps for increasing the viscosity and making a road tar might be less than the cost of providing stills for the same purpose for the preparation of a prepared tar. The capital cost of a plant for the preparation of road tar only was comparatively low; higher capital costs were reached at a stage beyond the primary distillation. Expensive plant was required in the rectification of the products. Therefore, there could be very great differences in cost of putting down plants.

He was putting forward these criticisms—Col. Carr continued—for his own personal enlightenment because, definitely, he considered the subject of the paper to be a most important matter to the Industry as a whole. He desired that his criticisms should be fully and completely answered. The maximum capacity of the Stretford Gas-Works was 5 million c.ft. per day, and he understood that the maximum capacity of the works at Partington was in the neighbourhood of 8 million c.ft. per day. Probably the Bradford Road Works were a little larger still. Assuming that there might be a maximum of 12,000 tons of tar to be dealt with in any of these works, it was difficult to appreciate how tar distillation plant for the distillation of tar to products could be installed at a capital cost that would compare with a large plant to deal with, say, 40,000 to 50,000 tons of tar. Personally, he felt certain that it could not, and that there was not much to be said on the question of saving of capital cost.

Mr. Holton had suggested in the paper that he had given information which would enable gas-works engineers to prepare estimates as to what the result of the process would be in regard to their own works. He had tried very hard during the past week, since he had had the paper, to prepare an estimate as to what the result of the process would be on his own works, and he had entirely failed to do so. This failure, of course, might be due to lack of understanding the points put forward.

He wished to deal with the claim that a saving of 5s. per ton could be made, and in connection with this point he would state some figures. It was a sheer impossibility for any such saving to be effected on the basis set forth in the paper. Therefore, he had to join issue with Mr. Holton upon that point. He had audited figures of a scheme involving four or five works, the operations of which were sufficiently extensive to enable him to say that the figures were on an actual working basis and that they included all costs. With regard to primary distillation, general labour, steam labour, fuel, repairs, reception of crude tar, fuel for stills, siding engines for shunting, laboratory materials, removal of refuse, &c., 3s. 4d. per ton of tar. Major repairs, exclusive of major repairs to tar stills, 5½d. Repairs and handling of tar and creosote, repairs of subsidiary plant and storage plant, maintenance and handling—actual labour in connection with all the handling of creosote, refined tar and pitch ready for delivery—1s. 8d. Major repairs to plant including all handling plant, transport, &c., 7d. Total cost of primary distillation of products 6s. 0½d. Overheads, 4½d. per ton—namely, staff charges. Gas, water, electricity, 2½d. Management charges, salaries, and all profit and loss accounts items, 1s. 6½d. Interest on capital, 1s. 11½d. Miscellaneous charges in connection with valuation of products and accountancy charges, &c., ¾d. This made the working expenses at the works 10s. 11½d. On those items, saving could only be effected with regard to two—fuel and labour. It would be necessary to have some technical staff at the gas-works. It was all very well saying there was already a staff that could do the sales work. He, personally, at Stretford would be very reluctant at the present time, and on present values, to sell tar products; because he had quite sufficient to do to sell his own gas and his own coke. In order to sell tar products skilled people would have to be employed, and there would have to be equally skilled knowledge on his Board.

A Vital Point.

He thought that some saving could be made so far as refined tar was concerned, provided that refined tar could be produced to a standard quality and it could be guaranteed to the surveyor that the 100th barrel would be exactly of the same standard as the first one delivered. Such a guarantee was a vital point which must not be lost sight of, because one of the great bugbears of the past had been that tar of varying quality had been delivered to surveyors all over the country, with the result that tar had been given a bad name generally. Having once made a tar to suit a particular surveyor it was necessary to be able to guarantee to him that every subsequent delivery would be exactly the same.

The Manchester Corporation were very much richer than the Stretford and District Gas Board. They might be able to afford to spend £10,000 or £20,000 on tar plant, whereas a small gas board like that of Stretford could not entertain the idea. Nevertheless he suggested, and he did it very respectfully to Mr. Holton, that it was necessary to be very careful before jumping at conclusions. On the evidence in the paper, there was nothing which convinced him that he should adopt the recommendations which were so strongly emphasized.

There was a most important point of which, apparently, Mr. Holton had entirely lost sight. He stated that gas undertakings might sell direct. His own view was that gas undertakings could not sell direct, and that even the Manchester Corporation could not do so efficiently. They had not got the necessary staff to sell direct efficiently, and he very much doubted if the Manchester Corporation Gas Committee would be prepared to go to the expense of employing a staff which had experience of the tar market. He knew the Stretford and District Gas Board were not.

With regard to the system of selling through agents, he considered that would be the most retrograde step the Gas Industry could take. When tar was being sold under the sliding scale, there were enormous fluctuations in the prices of products.

Were they going to put themselves back into that position? Could they afford to do so? Owing to co-operative working they had now got together and had been able to form the pitch group. If there had not been co-operative schemes the pitch group could never have been formed, and the price of tar, which to-day was round about 45s., would have been round about 25s. Attempting, individually, to produce products in competition, and compete in the home market, would be disastrous.

He was giving nothing away when he stated that, regionally, a fair road tar price was being charged to the user of the road. They had got bitumen controlling the price of road tar, and in order effectively to cope with that control necessary economies had been made, the final result being a better price owing to co-operation. Mr. Holton suggested that they should again become competitors, and that small individual gas-works should again produce tar of varying qualities. He repeated that it was a most retrograde suggestion, and one which he hoped would not be listened to in the Gas Industry.

Plant already in Existence.

Mr. Holton had suggested that tar producers might participate in one of the existing co-operative schemes. He, Col, Carr, agreed. But the necessary plant was in existence. Speaking of the co-operative scheme for Lancashire, with which many of those present were associated, they, as producers, were in control of the scheme. They already had their plant. If they were to put down additional plant at their works, and make the plant they already had, on very low and very favourable terms, unremunerative, how could the existing co-operative schemes continue to take the products and pay the same price for tar as they were doing at the present day? That was a question he would like Mr. Holton to answer.

Mr. Holton suggested they should set up a co-operative tar scheme within the Industry itself—namely, to disregard all those distillers' works which were in existence, and provide and finance the whole of their co-operative schemes from within the Industry. There would have to be some more justification than the mere scrapping of so much of what was already in existence, and they must have some very bad agreements to justify such a course of action. It was to be doubted, also, if there was an organization in the Gas Industry which could successfully conduct such a business as a co-operative scheme covering the tar of the whole country. Co-operative schemes were being conducted, of course, with the assistance of men who had been working at selling tar all their lives. They had an equivalent interest with the gas undertakings. They had a great incentive to push the sales of tar, because unless they obtained a high price for it they could not pay a dividend, and that dividend had been brought down to a low basis. There was the same safeguard with the co-operative scheme that there was with the gas consumer, but there was also much more. There was an incentive behind the salesmen and the technicians which obliged them to put forward their biggest effort in order to obtain a sufficient return on their capital. Did Mr. Holton suggest that they could afford to forsake such a safe basis upon the arguments he had put forward in his paper?

He hoped that the points he had put forward could be elucidated, and that they would not go away from that meeting feeling that they were going to carry out a revolutionary scheme unless they were definitely satisfied that they were going to receive a higher price for their tar, having regard to both the technical and the commercial side of the question, and also that it was going to mean a lower price for gas to the gas consumer, which was the ultimate object for which they were all working.

Electrical Precipitation.

Mr. E. Crowther (Engineer and Manager, Bradford Gas Undertaking) said the process described was exceedingly interesting, but seemed to be one which was rather back to front.

Both the gas and the tar left the retorts at a temperature higher than the temperature necessary to produce the road tar which Mr. Holton had in view. That was the ultimate product of the process. When he referred to the tar he meant the tar produced from the coal in the first place. Surely, if one wanted to get dehydrated tar to a given specification it would be very much easier to precipitate it electrically, or otherwise, before it came down to a final temperature—namely, one would lag one's foul main and conduct it to an electric precipitator. The tar would then come down at any temperature at which one could control the precipitator, and, presumably, it would then have the desired specification. The gas would go forward to further condensers where the light oils might be brought down.

Judging from the quantities indicated in the paper one could only handle something like 5 gallons of tar per ton of coal that was being distilled in the retorts. No doubt if one was making, say, 12 gallons of tar from the original coal, there was still an accumulation of tar going on in the well, in spite of the process described. Again, what sort of tar would be going to the well when the process had been in operation some time? He assumed that in starting the process it would be done on a scale relatively small compared with the size of Mr. Holton's works.

It appeared to him that the process was going a very roundabout way towards its final object. It started with hot tar as it was prepared from the coal in the retort. It was cooled, and then brought back and warmed up again in a state of mixture with further crude tar being produced. Secondly, it was not possible to deal with the whole of the tar produced by means of the method described; there was merely an alteration of the composition of the stuff which eventually found its way to the well and which could not be dehydrated in the process.

Col. Carr's point with regard to the transference of benzole to the producer gas at Partington had also occurred to him. Upon the figures he had taken out he estimated that on a seven days' trial run at least £2 a day was being lost financially by transferring thermal units from benzole which would have been recoverable. He took it that producer gas could be generated at something like 1½d. a therm and six times six million cubic feet represented £14 worth of gas, whereas as benzole it was something like £30. This seemed to be a serious criticism, though it probably did not affect many of those present, as most of them had not the necessary source of sensible heat to work on. He considered that Col. Carr had really given Mr. Holton sufficient to think about concerning the financial side of the question.

Specialized Sales.

Mr. A. L. Jennings (Spenborough) wished to confine himself more particularly to the conclusions drawn by Mr. Holton. The Gas Industry was now in a position of manufacturing very much more gas than it was in a position to sell. It might be that gas engineers, who, in past years had spent much time in perfecting the manufacturing side of their plants, and in reducing the manufacturing cost of their gas, would possibly have done better if they had devoted more of their energies to the perfecting of appliances for the sale of gas and in gas sales organization. Considerable sums of money had been spent upon gas-works, and also in attempts to reduce the price of manufactured gas, and the reduction which had been effected was in the region of ½d. or ¾d., or a fraction of a penny. Finding that they were in competition with solid fuel or with oil, in order to secure business it was now not merely a matter of reduction of a fraction of a penny, but of 6d. or 1s. per 1000 c.ft. Therefore, it seemed probable that it was really on the sales organization of gas that it was necessary to devote more attention. It appeared to him that what was true of gas was equally true of tar. If it was true that vertical retort tar was not suitable for manufacturing into road tar, which was not the case, then he could well see that the installation at gas-works of such a plant as that described by Mr. Holton would be a matter for very great consideration by the Gas Industry.

Speaking as the Manager of a medium-sized works, turning out a little over 300 million c.ft., he had never yet had to consider the problem whether or not it was a commercial proposition to put down a tar works, as he probably would have had to do if he had been in charge of a big undertaking similar to those owned by several of the cities in this country. Nevertheless, it had always been present in his mind that it might be quite possible to effect economies in gas-works and the distillation of tar by a saving in fuel and in carriage costs, and possibly by profits in other directions, but that it was much more likely that any economies that were so made would be offset owing to the fact that the products of tar were so multifarious. The markets changed to such an extent, and the knowledge of them was such a specialized subject, that anything saved in the manufacture of gas would be offset by selling through people who were not specialists.

Mr. Holton had stated that 60% of the tar which was produced in gas-works and in coke ovens in this country was sold for road purposes. If that was so, then he was exceedingly surprised. He should have thought it was very much nearer to a third of that figure, though he might be quite wrong.

Mr. Holton had stated also that the tars which were produced in the plant conformed to the B.S. specifications. That might be so, but he had not told them something else. The tendency in regard to road tar was not for tars to be required nowadays of low viscosity, but of high viscosity of 200 to 300 seconds. It might be that those tars were not so foolproof in application, but they gave a much better road and longer life. Could the plant described in the paper produce tars conforming to such high viscosities?

Again, it seemed to him that if a gas-works sent its tar to large tar distillers, the mixture of vertical retort and horizontal retort and other tars was a gain to all the tars concerned, while if a gas-works was distilling its own tar the benefit of blending was not obtained.

Another point which the paper seemed to raise was that Mr. Holton advocated the gas undertaking selling its own products. If it did so, then it must take those products away from the existing tar distilleries; and seeing that they were dealing with a lesser tonnage, then the overheads of the gas undertaking would be larger.

Unless there was a great deal in the paper which had escaped his attention, it seemed to him that it would be very much better for gas engineers in this country to concentrate upon utilizing the tar plants which were already in existence and which were more than capable of dealing with all the tar products.

Mr. Norman Hudson (Mirfield) spoke as a gas engineer in charge of a small works. He noticed that in various parts of the paper it was definitely stated it would be to the advantage even of the small works to adopt such a process as that described by Mr. Holton. The details given were, however, rather vague, and one was left to guess quite a lot. He could not see that the process, as at present outlined, would be at all applicable to a small gas-works.

Col. Carr, in his remarks, made reference to a number of unknown constants in the operation of the plant. That was a stumbling block to the manager of a small works. Provided there was adequate control of such a plant, then all would be plain sailing. They were given an unknown factor for the time of contact of the tar with the gases, and unknown factors in other cases. The manager of a small works, in the old hackneyed phrase, would be a Jack-of-all-trades. He would not be at the works all day long. He certainly might have a capable assistant who could not be running the tar process all day long. The result would be that a small company making tar for road purposes would probably have complaints about it and have some of it sent back because it did not comply with the specification. It would be a far safer policy for the manager of a small works, in his opinion, to leave the satisfaction of the user of road tar to people who were competent to give him that satisfaction, rather than to start taking on any process which was not sound and not very foolproof in its operation. Unless Mr. Holton could develop the process until it was more rigid and more foolproof, he did not think the manager of small works could do better, for the present, than to leave the sales of road tar in the hands of people who knew how to make it and how to sell it.

The Author's Reply.

Mr. Holton, in replying to the discussion, said that he was not going to let it go unchallenged that the Gas Industry was so impoverished in brains, ability, and initiative that they could not tackle the problems that he had set before them. He regretted very much that one or two of the speakers had ventured on the idea that this would be the last straw that would break the camel's back.

He was charged with being a little bit vague in the paper, but he ventured to disagree with that statement. It was no use saying that 12½% of the tar in this country was produced as road tar; the Board of Trade figure was 60%.

It was distinctly stated in the paper that the process could go to soft pitch. Why Mr. Jennings spoke about high viscosity tars he failed to understand. It was also distinctly stated in the paper that the process was to work up a fairly high viscosity tar on to one tank and to work on to a low one on the other. If a customer wanted a particular viscosity it could be given to him; it was merely a case of blending. Personally, he could not see that there was any difficulty which was insurmountable in the points raised by both Mr. Jennings and Mr. Hudson.

As far as the small works itself was concerned blending was a very simple operation. In regard to the preparation of road tar, the fact that it was down in the hydraulic main, as was distinctly stated in the paper, gave it an added advantage in regard to its phenolic contents, which was a fundamental in road tar because of toxic difficulties that had always existed.

Mr. Crowther mentioned that fractional condensation had been attempted. There had been quite a lot of work done on the matter in America in recent years, and it was found not practicable. The process described in the paper had been found to be practicable, and the Americans were producing high viscosity tars. In that country, in recent years, the tendency had been for the tar to be treated at the works to the extent of 50%. Possibly if a little attention had been directed to that matter while some of their friends had been in America they would have had the benefit of enlightenment on that point. There had been a decrease of the tar which was being treated at the works of distillers.

In answer to Mr. Crowther, there was no accumulation of tar. The tar was circulated, and brought down at the circulating well either on cyclonic or electric or any other principle that was desired. What went forward to the condensers was distinctly a creosote. If there was recovery of benzole, its nature was such that it was particularly adaptable for the purpose.

He had not made claims in the paper for which he could not produce the necessary data, in spite of his alleged vagueness. The general tendency at the present day was to recover benzole. He had not mentioned it in the paper because he could not give the exact figure, but undoubtedly the benzole that was present in the tar went forward, and a large percentage of it was retained in the gas, and then recovered in the benzole plant. In his 5s. he did not make allowance for that, but it was there, and was an added attraction to all who had benzole recovery plants. Mr. Crowther was mistaken in saying that producer gas was used at Partington, but it was used at the Bradford

Road Works. At Partington experiments had been made in regard to the work on the hydraulic main.

He appreciated quite sincerely the very close criticism that Col. Carr had given to the paper, and because of the fullness of that criticism it was necessary that he should answer it as completely as he possibly could. As a preliminary word, he wished to state that the Manchester Corporation was not the first to make investigations. Feld, twenty years ago, was experimenting, and the Barrett process was being worked, and was being extended, in America at the present time very greatly.

Because someone had a big capital, and had worked on a process for many years, that was no reason to him why a fresh field should not be investigated. If the new process did not show any advantage over the other, then there was no reason to go on with it. To tread the way their fathers trod was not the way to make progress.

Col. Carr had asked for figures, and he could give them fairly closely. The price that was stated for distillation was fixed—it was the price that he paid—and for the production of road tar at the gas-works it could be done at 15d. to 18d. per ton. His price of 10s. per ton was substantiated on that figure.

Col. CARR thought there was a misunderstanding between Mr. Holton and himself. The figures he had stated were on an analysis of the accounts of the Lancashire Tar Distilleries, which he was quite prepared to put in as evidence. Those charges included all sorts of things like storage tanks and all other subsidiary appliances.

Mr. HOLTON said that his early training was that of a chemical engineer. Therefore, he was fairly conversant with the costs of tar distillation on a large works. The figures that Col. Carr had given substantiated to a very large extent the figures he had always had before himself and on which he had based his point. When he spoke about a figure of 5s. or 10s. he spoke of a figure that was charged for what was done.

Years ago he was convinced that a great deal of the cause of the bad name for road tar was simply due to the fact that a number of works were sending out any kind of stuff. Tar distillers had deplored this fact to him, and had stated that it was giving road tar a bad name. Personally, he welcomed the Road Tar Specification, and would even go so far as to state that it was not the last word on the point and that it could be made more stringent. He did not advocate that it should be made more stringent, but he did say that it could be made so.

He thought most of those present would know the process of cutting back, which was quite a simple one. It was possible to circulate in the high-grade of the No. 3 Road Tar Board Specification. It would be no deterrent to him to adopt the process simply because he was told that in another year there was going to be a very stringent specification.

Of course, it was necessary to meet the viscosities to a very fine degree, but there was no difficulty about it once the tank was set up. It was merely the job of an intelligent youth, and he could do it quite easily.

With regard to synchronizing the temperature and the circulation the chart attached to the paper gave a very good indication, approximately, as to withdrawing the tar.

With regard to the loss of the benzole in the producer gas run, he admitted that that was definitely against where it was simply used for producer gas. It was an advantage when the circulation and the distillation was done in the hydraulic main.

Col. Carr had asked for the data with regard to fuel. That matter was mentioned in connection with the cost of the preparation of road tar. The paper dealt mainly with the road tar position, and he had not suggested that all of them should go right to final products. The amount of ash that was brought down with the producer gas was very small, and the figures were given. What were not given, and what he had done in preparation for replying to the discussion, were with regard to the ash in the pitch which was to be solid. Taking from Aug. 11 to Oct. 24 the ash content in the pitch was 0·35. It would possibly be said that in the circulation of the tar in the hydraulic main there would be a considerable amount of ash brought down by dust, &c., accumulating. Those who operated vertical retorts knew well that there was a pontoon, or whatever they liked to call it, where there was a digging out of a thickened tarry mass, and it was usually burnt in the producers. This would contain the bulk of the added ash that was going to be detrimental to the pitch on final production. There was not 0·5% of ash in it; therefore the ash content would not be high.

There would certainly be elimination of carriage costs from the gas-works. It was desirable to get rid of the barrel trade. He was quite aware, of course, that the carriage costs on finished products were higher, but this was a matter of the location of the particular works.

Col. Carr had suggested that the circulating costs were rather high. Why should they be any higher than the circulating of the liquor in any vertical installation? They were not any higher. The pump would not have to work any faster, and there was merely the substitution of tar instead of liquor. Even if the wages of a gas-works employee were higher than those of the men in a tar distillery—say, 10% more—the extra cost would be very slight.

It was practically a matter of special accountancy to arrive at the amount of coal that was used on the stills and the percentage that was used on refining. There was certainly less water used in the producer gas plant on the first down-take of the producer gas where the dust was eliminated with water. The dust had been given in a former Trefois paper, together with the ash content, and it was reiterated in the paper under discussion.

Col CARR: May we have the water on the other portion of the plant, which is the bigger issue?

Mr. HOLTON: Well, there was water on the other plant before.

Col. CARR: I want to know where the saving came in on the coal gas. I had not in mind producer gas.

Mr. HOLTON said that Col. Carr would agree with him that the function of the hydraulic main was not that of a condenser, even as it was used nowadays. Liquor was pumped to get the dust down, and so on, but the heat of the transfer was first transferred to the condensers where the water was brought down in liquor. As Col. Carr had pointed out, the high cost was on the refining of products and not on the primary products. He had never suggested undertaking refining, and would not suggest it for a moment, unless it was to be on a big works, like the Gas Light and Coke Company, the South Metropolitan, Newcastle, and one or two other works which did go in for refining.

He did not suggest that they should sell their tar; it should only be done in cases where there was special knowledge. He had mentioned three works which sold their own to advantage. It was, however, possible for them to sell their own tar. They had sold their own sulphate of ammonia for years through accredited agents and had not done badly by it. Why should they do badly if they sold their tar through accredited agents?

There was much to be said for collective effort; one advantage being that wasteful competition was avoided, and he would be the last one in the world to suggest that they should sell their tar in competition with one another—any more than they should sell their coke under the same conditions. He was not going to be led into a discussion, however, with regard to pitch pools and quotas for road tar.

Col. Carr had concluded his criticism of the paper by a statement that the scheme was revolutionary, and that it involved the scrapping of a great deal of plant in the works of distillers. Nevertheless, if a process came out in any portion of the gas field of activities which was a decided improvement upon what had gone before he was going to examine it, and, if possible, to work in co-operation with it. Any new development must be faced in that spirit, and if it was, then, in his opinion, the Gas Industry did not stand to lose thereby.

Mr. E. CROWTHER (Bradford) proposed that a cordial and hearty vote of thanks be accorded to Mr. Holton for his paper.

Mr. W. J. SMITH seconded the vote of thanks, which was carried unanimously by acclamation.

A "Spotting-the-Bargain" Competition

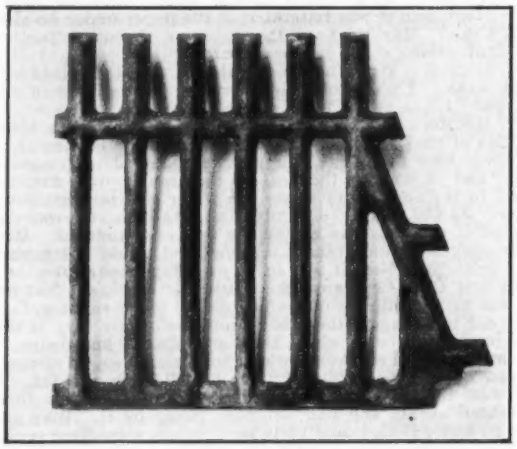
An interesting competition was recently arranged by the *Cheltenham Chronicle and Gloucestershire Graphic*, of which our photograph shows a part in the showroom window display of the Cheltenham and District Gas Company. Four window displays were illustrated in the newspaper, and each contained many examples of excellent value. Readers were invited to study the actual windows carefully and send a post-card to the paper stating what they considered the best bargain in each display and why. A voucher for the supply of food to the value of £1 was presented to the writer of the winning post-card respecting each window.

NOTES ON PLANT AND PROCESSES

A Heat Resisting Steel Grate.

The latest attractive feature to be added to " C.C. " fires manufactured by J. Brockhouse & Co., Ltd., of West Bromwich, is a heat resisting steel grate bottom which will stand up indefinitely to a coke fire.

This new grate bottom is of cast steel having a high chromium content, and is made by Hadfields, of Sheffield. These grates are made in various sizes to fit the usual standard fireplace, and by sawing off the projections as required, they can be made to fit practically any fireplace. However, for exceptional cases, heat resisting grate bottoms are supplied. These are of the same quality steel, but are in rolled rods of $\frac{3}{4}$ in. diameter, which can be cut up and fixed to make a grate bottom of any size which may be required.



Heat Resisting Steel Bottom Grate after being tested up to 1000° C.

No distortion or growth of any kind.

A test has been carried out by the Chief Engineer of Messrs. Brockhouse. The new steel grate was suspended half an inch above a coke fire stimulated by forced draught.

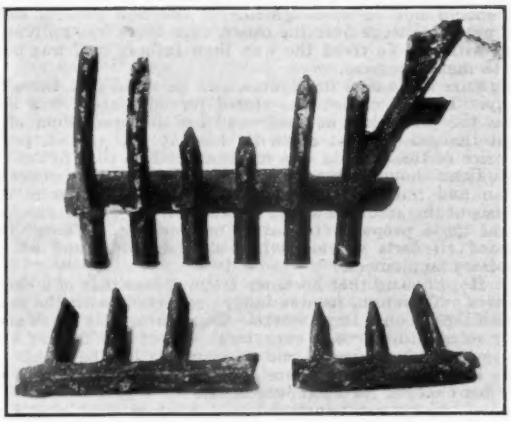
The greatest temperature usually reached in an open fire is 800° to 900° C. At this temperature no effect was apparent in the steel grate bottom, but a cast-iron grate bottom showed signs of growth and of deterioration through the action of the sulphur emitted from the fire.

At a temperature of 1000° a normal cast-iron grate bottom broke and melted, and the distortion is illustrated by one of the accompanying photographs; as yet there is no effect on the steel grate bottom.

A Cast-Iron Grate Bottom after 900° C.

Distortion and growth are apparent.

Experiments have been carried out in placing the grate bottom in the centre of the coke fire, and a temperature of 1700° C. was reached before the steel grate bottom broke, then it was found to have cracked across the weakest section, and even then there was very little distortion, and very little growth was apparent.



Heat Resisting Steel Bottom Grate after 1700° C.

It has broken, but there is no distortion or growth. Owing to the intense heat of the fire, various residues of the coke and iron are deposited on the surface. There is no scaling.

It is of interest to mention that when the fire was at a temperature of 1400° C. a piece of spring steel was inserted but melted away while it was being pushed into the fire.

New High-Pressure Laundry Iron.

A new 8-lb. iron has been designed by Messrs. James Keith & Blackman Company, Ltd., as the result of lengthy experience with high-pressure gas irons, and has certain novel and patented features. The burner is actually formed in the sole of the iron itself, and is so arranged as to give a very even distribution of heat. If there is a faulty distribution of the heat, irons get too hot in the centre, leaving the sides of the heel too cool. This fault has been effectually overcome in the new arrangement. At the same time the new type of burner has overcome the difficulty of " whistling " occasionally noticeable with the older types, especially where high heats are desired.

The products of combustion are discharged through sawcuts so as to obviate the possibility of actual flame issuing from the outlets. The injector is designed so as to minimize the possibility of choking up with fibrous dust, the adjustment being so arranged that the point of constriction is not at the entrance for the air, but in a hot portion of the iron, so that there is little tendency for " felting " of the fibres, as they become dry and brittle. At the same time the injector is arranged to be unscrewed at the air inlet piece, which permits of the injector being easily cleaned without upsetting the adjustment. It is, however, usually sufficient to clean the iron by exploding the contents of the burner by lighting at the air intake. The adjustment is made by a differential screw, which enables a fine adjustment to be easily made with a wire " tommy."

Repairs to Reinforced Concrete—by Cement Gun Method*

By George C. Pearson, M.Inst.Gas E., of the Birmingham Corporation Gas Department

The use of ferro-concrete for certain structures in gas-works has become fairly common practice during the past few years. While there is little in first cost between ferro-concrete and steel construction, and the actual time taken for erection is considerably increased by the use of ferro-concrete, there are positions in gas-works where plant is subject to considerable corrosion; and the useful life appears to be extended by the use of ferro-concrete. The fact that ferro-concrete may require little attention after erection should save considerably in maintenance items such as cleaning, painting, and repairs. Concrete has proved itself to be useful in such positions. It is of prime importance, however, that great care should be exercised in the construction of ferro-concrete, and to give satisfaction and long life many points must receive careful attention.

Construction During the War.

The methods that should be adopted are now generally recognized by all competent construction firms, but even to-day it is not possible to standardize workmanship. Modern concrete construction, however, may be considered as generally satisfactory, but there are a considerable number of structures erected 20 years ago, or during the War period, where, owing to inexperience of this type of building, the necessary attention to details of workmanship during construction was not always observed. Further, the compressive test of the British Standard Specification for cement and sand after 7 days has advanced from 200 lbs. in 1912 to 375 lbs. to-day.

Deterioration of Concrete.

The reconstruction of Windsor Street Gas-Works, which was commenced just prior to the War, had to be proceeded with under war conditions. Owing to the difficulty in obtaining steel, ferro-concrete had to be adopted for many purposes where the former would have been preferred. Not only was ferro-concrete construction then rather in its infancy in this country, but difficulty was experienced in obtaining suitable materials, and the labour necessarily employed was quite unused to the type of work required. Concrete construction included sub-structures for cast-iron purifiers, sub-structures for Woodall-Duckham vertical retorts, coke crane gantries, coal hoppers, &c.; and in many cases deterioration of these buildings has set in. It is possible that other gas-works may have a similar experience with ferro-concrete constructed some years ago, and that a description of our methods of repair may be of use to the Industry. Deterioration reveals itself first by the appearance of fine cracks that open up as time goes on, and extend until pieces of the structure flake off. It is at once apparent that the cause of this shattering of the surface of the concrete is the corrosion of the internal steel, the consequent growth bursting off the surrounding concrete. Should no action be taken then, this corrosion will extend in all directions along the steel, while the core may be badly damaged.

Some Causes of Deterioration.

The principal causes that bring about such conditions may be as follows:

Insufficient Cover.—It is sometimes specified in heavy concrete construction that the cover of concrete over steel reinforcement shall be in the region of only ¾ in. to 1 in. It is apparent that to arrange such a cover the steel must be most carefully placed in order that there shall be no winding or straying towards the surface of the shuttering, and thus cut down at certain points the depth of concrete cover allowed. Further, should the aggregate used be of, say, ¾-in. granite, it is liable against the shutters to bridge over the stirrups and parts of the reinforcement, and allow the liquid portion of the concrete to drain through, and thus leave porous patches. The necessary "tamping" required to consolidate the concrete is very difficult to carry out where such a small cover is allowed between the steel and the shutters, especially should stanchions be cast in long lengths. Further, all concrete is permeable; and in places where corrosive liquids may accumulate, internal corrosion of the steel can be more easily set up with the results mentioned.

Bad Mixing.—Good materials may be easily ruined by insufficient mixing. A mixer is of course usual for large structures, owing to the labour saved by this means, but a minimum time limit should be allowed that will permit a particular machine to make a consistent concrete, and this period should be strictly adhered to. Bad mixing will rapidly affect the permeability of the concrete, bringing about excessive aggregate in certain positions. (See Plate VIII.)

Insufficient Tamping.—Stanchions should be cast in short lengths, and all concrete should be well tamped when placed in order to bring about consolidation and the minimum of voids. Where this practice is neglected voids 4 in. in diameter may occur. "Tamping" also has the effect of bringing excess water to the surface, where it may be removed, and of dispersing any accumulation of aggregate that may have bridged over the steel work. (See Plate I.)

Plate I.—COKE CRANE GANTRY.

Stanchion stripped of concrete cover over steel reinforcement, revealing cavity in core caused by insufficient tamping when under construction.

Careless Placing of Steel.—Reinforced concrete designers often specify a number of bars to be placed about 2 in. apart. In order to maintain such bars in position while concrete is filled in, spacing pieces should be used. Neglect of this provision often means that bars stray together, and leave insufficient room in places for continuity of concrete strength around them. Examine the lower part of the cross beam in Plate III.

Excess of Water.—Excessive use of water in the concrete over that required for cement hydration is probably the most usual of all errors that may occur. Excess of water means less work in tamping, and that the shuttering can be removed to show a better looking job. Further, less materials are used in carrying out the work, since the concrete takes up greater space. However the weight of concrete per c.ft. is less than it ought to be, and the strength of the structure is very materially affected, as I shall attempt to show later in the Paper. After the drying out and the excess water is evaporated, the concrete is left full of minute voids, and if examined under a magnifying glass has every appearance of pumice. The occurrence of such voids brings about permeable concrete; and infiltration of air and liquids can take place, with subsequent corrosion of the steel.

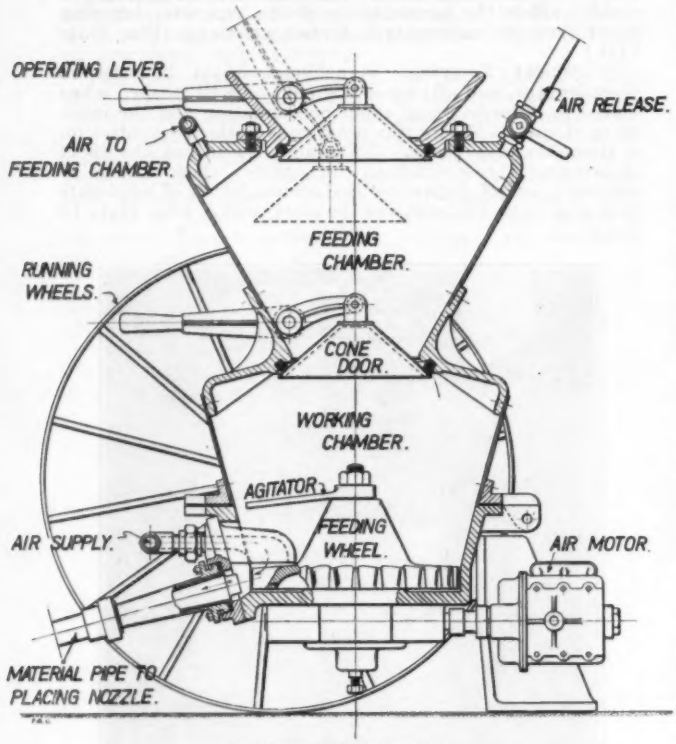
Unsuccessful Repairs.

An attempt to repair deterioration brought about from such causes by means of a trowel or float, with cement and sand mixture, is quite unsatisfactory. It is not practicable to clear the surface of the old concrete completely of sand and dust, and to trowel home the new concrete without air spaces between the old structure and the repair. Such

* A paper before the Midland Association of Gas Engineers and Managers, Oct. 26, 1933.

repairs appear to do more harm than good, as they often camouflage the further and extended deterioration that is taking place.

I found myself a few years ago faced with a very difficult position, as a number of ferro-concrete structures on the works were affected with widespread deterioration. The structures were so badly shattered in places that, in the absence of some efficient system of repair, it would have



Sketch I.—CEMENT GUN.

been necessary to condemn the buildings as unsafe. Careful repairs had been carried out from time to time by means of trowelling—on sand and cement mixture; but deterioration was not checked, and extended to an even more serious degree behind the repairs.

During the last few years I am glad to say we have adopted a system of repair that appears to be very effective, and while by no means a new process may, in consideration of the investigations we have made, be of interest.

THE CEMENT GUN PROCESS.

The method referred to is that of placing concrete by means of the cement gun. With the use of this apparatus a sand and cement mixture is impinged into position under air pressure of about 40 to 50 lbs. The plant comprises an air compressor, a cement gun, and the necessary piping for conveying water, air, and material, and a placing nozzle. The air compressor requires to deliver 200 to 250 c.ft. of air per minute at a minimum of 80 lbs. pressure. The cement gun consists of a vessel designed to withstand at least 60 lbs. of air pressure, and comprises two compartments, an upper and a lower, separated by a flap cone door. (See Sketch I.) There is also a cone door in the top of the upper compartment through which cement and sand may be fed. A rotary feeder driven by an air motor regulates the flow of dry sand and cement from the lower chamber to the material pipe. Air pressure of about 60 lbs. is turned on with the top door closed, and with both compartments filled with cement. As the cement is used from the upper compartment, the middle door is closed and the air released from this compartment, when the top door can be opened and a further charge of sand and cement delivered into this vessel. The top door is then closed, and the pressure returned to that compartment. The middle door now opens by weight of the charge, and allows the cement to fall into the lower compartment, and so maintains a continuous stream of cement mixture along the material pipe carried by the air stream.

"GUNITE."

This mixture is taken in a dry condition to the placing nozzle. (See Sketch II.) At the placing nozzle is arranged a ring of water jets directed towards the centre of the nozzle; and as the mixture passes through, the intensity of the jets can be varied to allow sufficient water to wet the cement mixture satisfactorily on delivery. Wet concrete is thus delivered with considerable force, and the minimum of water required for setting. This concrete mixture is called "Gunite," and consists of three parts of sand and one part of rapid hardening cement.

We have made a large number of tests to investigate the efficiency of "Gunite," and the whole of the tests quoted in this paper have been carried out by the Birmingham Gas Department Industrial Research Laboratories.

COMPRESSIVE STRENGTH OF "GUNITE."

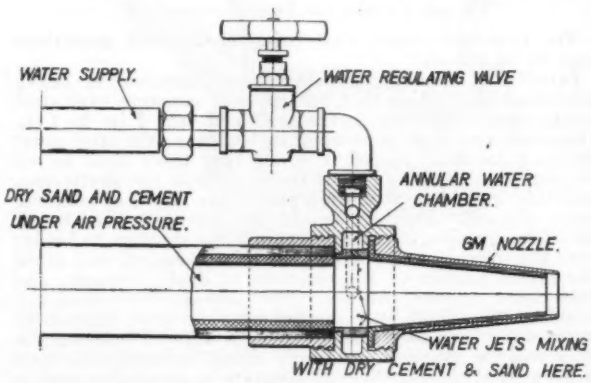
Tests made of the compressive strength of cubes cut from "Gunite" cast slabs showed that with a local single-washed sand and a 3:1 cement mixture a crushing stress of 3700 lbs. (in 7 days) was obtained compared with the usual 3000 lbs. (in 7 days) for good concrete. Tests of the sand used revealed the presence of organic matter, and it was soon apparent that care should be shown in the choice of sand used in the process. The working mixture calls for a quality that will aid the cementitious properties in the final setting, and should be entirely free of organic matter and marl particles. Further tests were accordingly made with the use of the local sand double-washed, with the result that the crushing stress of similar "Gunite" cubes was raised to about 6000 lbs. per sq. in. In view of the importance of quality of sand in production of "Gunite," it was decided to experiment with sand, from the well-known Leighton Buzzard beds, of a double-washed selected grade. A much denser type of "Gunite" was made from this sand, and the compressive strength of 3:1 mixture cubes was increased to the remarkable figure of 10,000 lbs. after 7 days. This sand is now in use for the repairs carried out at Windsor Street Works. It is obvious that the building up of a wasted member by the application of such a material should increase even upon the original strength, providing always in practice it is possible to place "Gunite" in position effectively.

APPLICATION OF "GUNITE" FOR REPAIRS.

There are several important points to be observed when applying "Gunite" for repair of ferro-concrete members. First, the whole of the loose concrete should be removed, and any corrosion chipped away from the exposed steel. The steel should then be wire brushed. In all cases where deterioration has taken place on any side or corner of a stanchion or beam the repair should extend round all sides of the member in order to maintain the continuity of the lateral strength. This is of primary importance, as a beam or stanchion with a plastic centre will carry a considerable load with safety, should the laterals be made good. On those surfaces to be covered where no deterioration requires to be removed the concrete needs roughing to provide a key for the "Gunite." We find this is best carried out by pneumatic scaling tools fitted with flat rose bits. These bits "chatter" away the surface of the good concrete, leaving a satisfactory key, and also serve to indicate any hollowness or looseness that must be cut away.

MESH FOR "GUNITE" REPAIRS.

In every case of repair by "Gunite" a reinforcement mesh should be fitted in order to take up and distribute shrinkage cracks in the "Gunite," and should receive


WATER SUPPLY.
WATER REGULATING VALVE
ANNULAR WATER CHAMBER.
DRY SAND AND CEMENT UNDER AIR PRESSURE.
GM NOZZLE.
WATER JETS MIXING WITH DRY CEMENT & SAND HERE.

Sketch II.—"GUNITE" PLACING NOZZLE.

about 1¼ in. of concrete cover. The maximum thickness of "Gunite" that can be placed at one time is about 1½ in. to 2 in. In places where a greater thickness is necessary, this should be placed in two layers, each with a mesh enclosed. The type of mesh most suited to large structures is 2½ in. to 3 in. square ⅛ in. dia., spot welded at each intersection of wire. It is important when fixing this mesh to maintain

lateral continuity, and that it should be tied in suitable places to the existing reinforcement. In the case of plain beams or stanchions, the mesh should be cut and bent suitably to enclose the member, and placed in position in two halves, and the sides should be laced securely down the seams by bending the overlapping parts of the mesh. At the junction of beams, haunches, &c., suitable mesh must be cut and laced to maintain the lateral strength, and suitably attached to the existing reinforcement. (See Plate VII.)

Procedure of "Gunite" Repairs.

While the sand and cement mixture is carried to the placing nozzle in a nominally dry condition, it will be found in practice that the sand must not be too low in moisture content. Should the sand be in very dry condition difficulty is found in wetting the mixture on delivery from the placing nozzle, and loss of material and considerable dust is the result. Should the sand be too wet, then the mixture is liable to block the material pipe. The correct consistency of sand is, however, soon found in practice, and maintained by judicious mixing and storage.

The stream of "Gunite" should be applied at right-angles from a distance of 2 ft. 6 in. to 3 ft. The reason for this is the rebound of the "Gunite" mixture. The mixture is 3 parts of sand to 1 of cement, and when the stream strikes an obstacle, and movement still continues, the sand is liable to separate out or rebound further than the heavier and finer cement. Should the stream meet the repair at right-angles, a minimum of rebound takes place, and the "Gunite" consolidates itself in a dense solid cover. For this reason the reinforcement mesh should not be fixed touching the surface of the old concrete, but should be spaced about ½ in. away from the face of the repair. Should the mesh be touching the old concrete, then the space immediately at the side of the wires and against the concrete is filled at once with rebound sand, and cannot disperse as the process continues. A hollow backing to the "Gunite" is thus formed, greatly reducing the strength of the repair. After all loose or hollow concrete is removed from the ferro-concrete member to be repaired, any good surfaces to be covered are roughed, and the reinforcement mesh fixed. "Gunite" is applied first to two opposite sides. Skeleton shuttering made of 4-in. by 1-in. strips is fixed to two sides of the member, and projecting beyond the face of the corners to a depth equal to that required for "Gunite" on the other sides. "Gunite" is then filled in level to the shutters, allowed to stand sufficient time for initial setting to commence—usually about 1 hour—and "screeded" level with the edge of the shutters to an even finish. The process will now have filled in two sides and the corners, leaving a panel on the two further sides to be completed. (See Sketch III.) The shutters are then removed; and the remaining sides first require thoroughly cleaning out of all rebound from the mesh by chipping and washing. These are then filled level to the "Gunite" first placed, and after setting finally screeded as before.

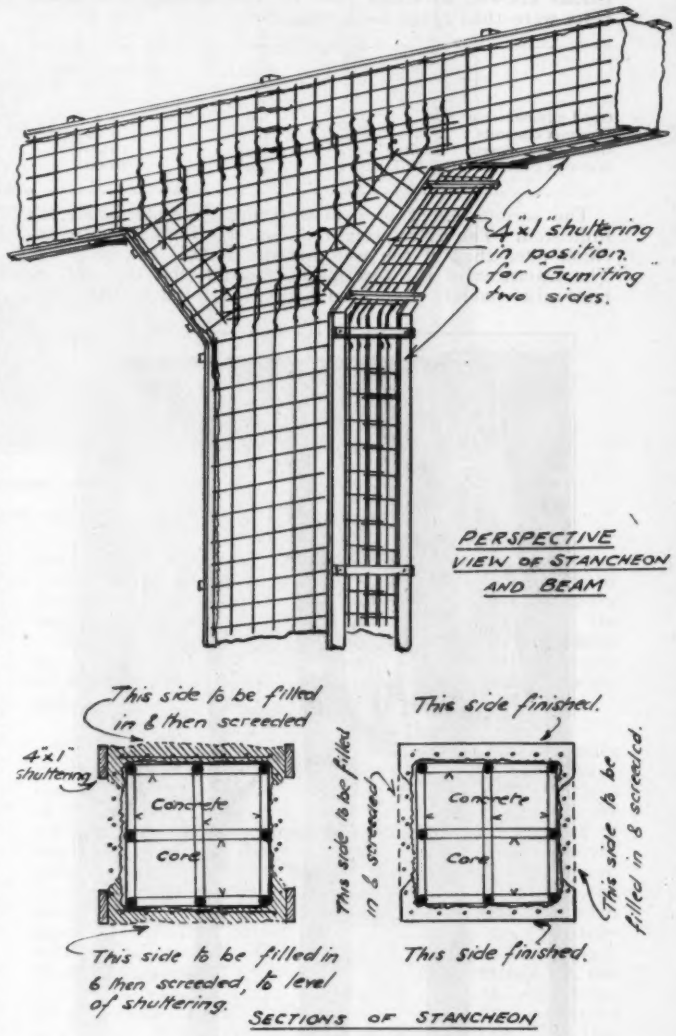
A Flash Coat Recommended.—As soon as possible after setting has commenced on the finished job a final or flash coat may be placed over the whole of the area. This coat of "Gunite" is only about $\frac{1}{16}$ in. thick, and is not touched in any way. This flash coat is not essential, but adds to the appearance of the job. Should the repair be tested with a hammer after a few days, the "Gunite" will be found to be very hard and quite solid on the concrete member.

Adhesion of "Gunite."—In order to test the adhesion of "Gunite," a block of concrete 6 in. by 6 in. was made about 1 ft. 6 in. long, and meshed and "Gunited" with 1 in. of cover on all four sides. This block was sawn through after a few days, and no joint could be found between the "Gunite" and concrete, even by means of a powerful glass.

Test Specimens.

A number of interesting tests have been made to establish the effectiveness of "Gunite" repairs. In each case three test pieces have been made, one of good-mix concrete, one of wet-mix concrete, and one of wet-mix concrete "Gunite" repaired. A consideration of the tests on three such samples allows the comparison of strength required. In most cases the improvement of inferior concrete to at least equal the strength of good concrete would be regarded as satisfactory. The meaning in this paper of a "good" mixture of concrete is one that will pass the balling test. That is to say, a handful of concrete taken from the mixer, and squeezed to a ball in the hand, should retain its shape. By "wet" mix concrete is not meant excessive watering, but a mixture that just fails to pass the balling test. Great care was exercised in the production of all the test pieces used in these investigations in order that extreme cases of wet- or dry-mix concrete should be avoided.

"Gunited" Concrete Block.—Three blocks of concrete were made of 4:2:1 mixture, aggregate granite ¾ in. to ¼ in., local good single-washed sand, and B.S. Portland cement. One block was made 6 in. by 6 in. by 8 in. deep of good-mix concrete. Two blocks were made of wet-mix concrete from the same mixing, one 6 in. by 6 in. by 8 in., and the other 4 in. by 4 in. by 8 in. These blocks were allowed to stand 14 days, and then the 4 in. by 4 in. by 8 in. wet-mix concrete was meshed and "Gunited" to the same size as the larger blocks. At 36 days all the blocks


4"x1" shuttering in position for Guniting two sides.
PERSPECTIVE VIEW OF STANCHEON AND BEAM
This side to be filled in & then screeded
4"x1" shuttering
Concrete
Core
This side finished.
This side to be filled in & screeded
This side to be filled in & screeded.
This side finished.
This side to be filled in & then screeded, to level of shuttering.
SECTIONS OF STANCHEON

Sketch III.

were tested for compression—22 days after "Guniting" the latter specimen.

—	Weight. Lbs.	Crushing Stress. Lbs. per Sq. In.
Good-mix concrete	153	3340
Wet-mix concrete	146½	2140
Wet-mix concrete "Gunited"	157½	3510

The advantage of good-mix concrete over concrete with excess of water is apparent, and it is seen that the wet-mix concrete is 4·3% less by weight. A cover of 1 in. of "Gunite" placed around a wet- or poor-mix concrete core has raised the strength of a block of similar overall dimensions to a higher compressive test than that of good-mix concrete. The blocks tested were plain without reinforcement, and a further test was made with reinforced stanchions.

Test on "Gunited" Specimen Stanchions.—Four stanchions were cast upright in suitable shutters 8 in. square and 7 ft. long. The reinforcement consisted of four ¾ in. indented bars spaced 5 in. apart, thus allowing 1½ in. cover of concrete, and hooped with $\frac{5}{16}$ in. wire spaced 6 in. apart. The concrete was 4:2:1 mixture, as above. The stanchions were filled from the front of the shutter 1 ft. 6 in. at a time, and were thoroughly tamped. Two stanchions were constructed of good-mix concrete, and two of wet-

mix concrete; each pair from the one mixing of concrete. Shutters were removed after three days, and the wet-mix concrete stanchions had much the better appearance. At the end of a month one wet-mix concrete and one good-mix concrete stanchion were cut away back to the steel reinforcement, removing the whole of the concrete cover in each case. These two stanchions were then meshed and "Gunited" to the original dimensions, and all four stanchions allowed to stand for a further month. Bending tests were then made to destruction.

—	Weight. Lbs.	Maximum Load. Tons.
Good-mix concrete	506	7·4
Wet-mix concrete	477½	5·27
Good-mix concrete "Gunited"	545½	10·29
Wet-mix concrete "Gunited"	529½	10·00

The serious effect of over-watering concrete is clearly indicated. The extra weight of concrete in the good stanchion over that of the wet mixture is 28½ lbs., or 5·6%. The fractures of the test pieces showed that the wet- or poor-mix concrete stanchion badly shattered at the point

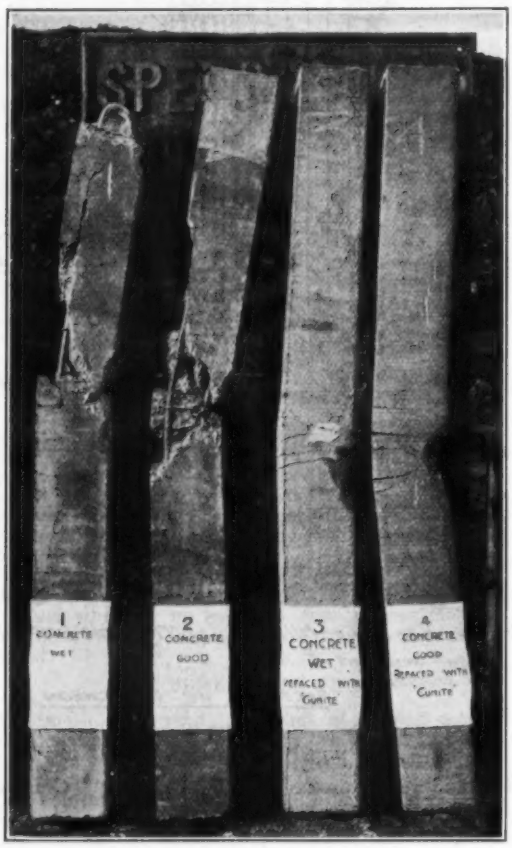
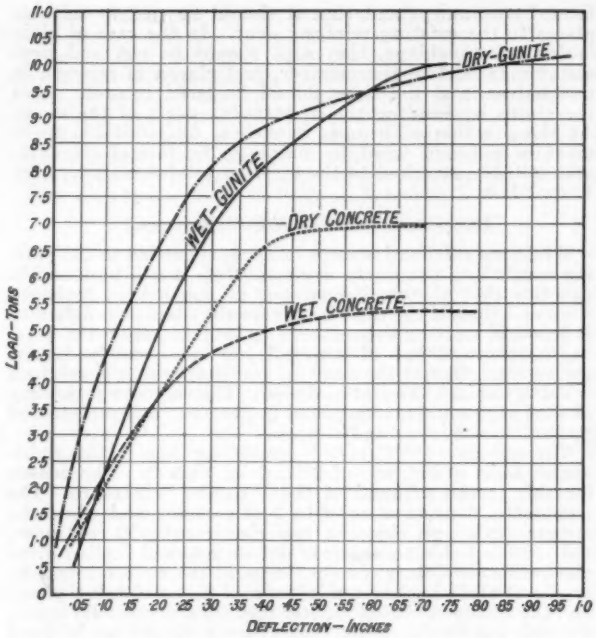


Plate II.—MODEL STANCHIONS AFTER TESTING.

of failure, and cracks extended to the end of the beam, the steel coming loose. The good-mix concrete stanchion shattered at the point of failure, but cracks did not extend the length of the beam. The two "Gunited" specimens cracked only at the point of failure, with no sign of any extension of cracks. (See Plate II.) The application of "Gunite" made the poor- or wet-mix concrete stanchion to more than equal the strength of good-mix concrete. The breaking stress of the steel indented bar reinforcement is approximately 40 tons. A calculation of the stress on sections gives the following:

—	Breaking Load.	Maximum Compression on Concrete.	Maximum Stress in Steel.
	Tons.	Lbs.	Tons.
Good-mix concrete	7·4	4100	28·5
Wet-mix concrete	5·27	2930	20·5
Good-mix concrete "Gunited"	10·29	5700	39·5
Wet-mix concrete "Gunited"	10·00	5520	38·5

It is seen that the good- and wet-mix concrete stanchions failed owing to compressive strength of concrete,



Curve I.—Bend Tests on Concrete Stanchions, 8 in. sq. by 7 ft. long, 6 ft. span, Central Load.

the good-mix concrete showing a considerable advantage. The "Gunited" stanchions failed owing to tension in steel, and had been strengthened up as high as was possible with the reinforcement used. This explains why the good-mix concrete "Gunited" showed no advantage over wet-mix concrete similarly treated. Deflection curves taken under test are given, and show a marked advantage for the "Gunited" specimens—Curve I.

Repairs to Purifier Building.

The first large-scale work attempted was the repair of a ferro-concrete purifier building. The building accommodated 12 cast-iron purifier boxes, each 37 ft. by 32 ft. in two sets of 6 boxes each, supported on a concrete substructure 15 ft. high. The concrete stanchions are continued to support a concrete revivifying floor, and a wooden Belfast roof. Considerable deterioration of con-

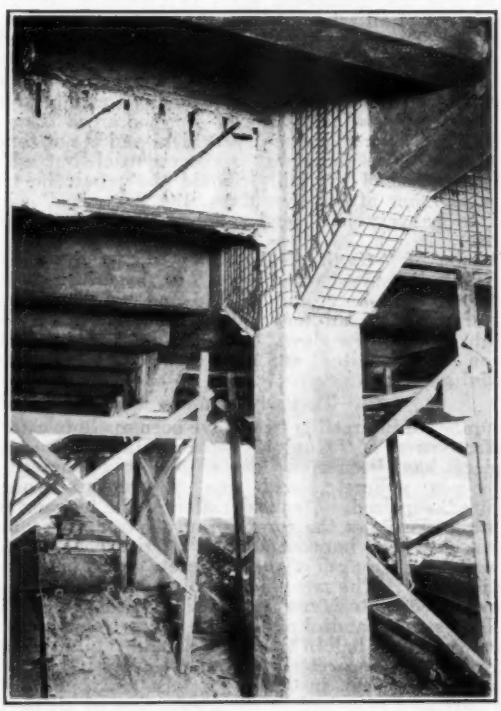


Plate III.—PURIFIER BUILDING, REPAIRED STANCHION.

Haunches meshed and shuttered ready for "Guniting." Note reinforcement bars at bottom of beam.

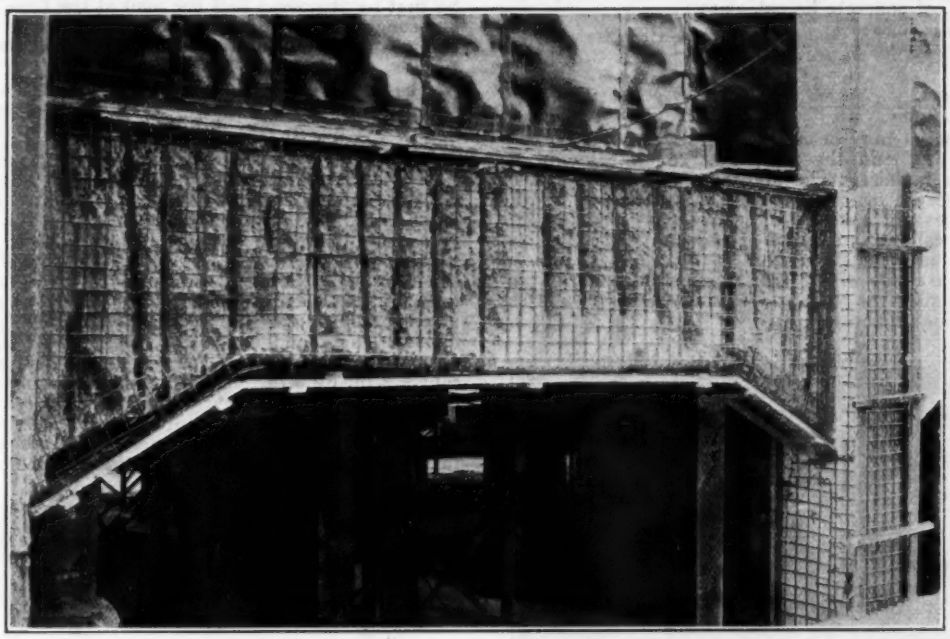


PLATE IV.—PURIFIER BUILDING.

Meshed beam with loose concrete removed and shuttered ready for "Guniting."

crete had taken place, and typical examples of the work are indicated in Plates III., IV., and V. The repair has been satisfactory, and after two years shows no sign of further deterioration.

Uses of "Gunite."

"Gunite" can be used for a variety of work such as chimney lining, &c., and it is especially useful for the wearing surfaces of shoots, such as steel coke shoots, &c. A mesh is fixed about 1 in. from the face of the steel by bolts, and "Gunite" applied in the usual way. Plate VI. shows the repair to a concrete hopper (used for coal and coke) that was strengthened and relined throughout.

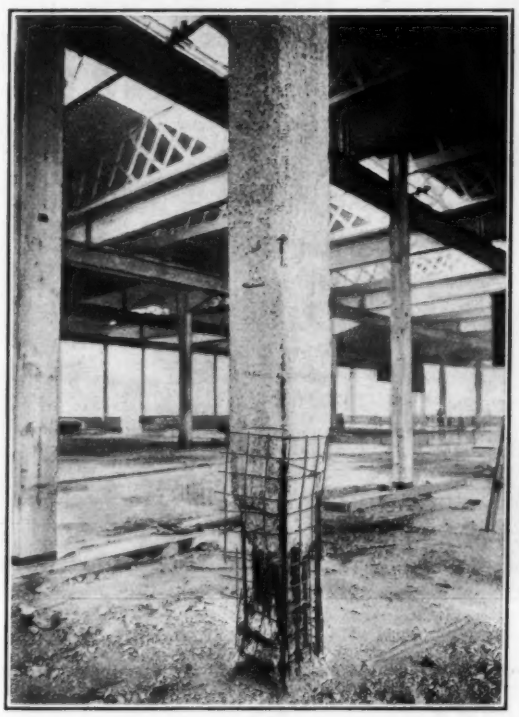


Plate V.—PURIFIER BUILDING, REVIVIFYING FLOOR.

Instances of badly shattered stanchions. Note propping at side.

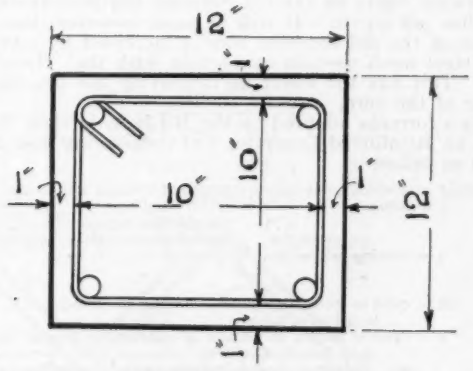
"Gunite" is expensive, and in some cases the cost of a repair may represent a sum about equal to the cost of the original member. It must be noted, however, that probably few members only of a building are in a really bad condition, and in the very worst of cases the necessary repair would be unlikely to extend beyond 30% of the structure. Further, the building can continue to perform the work for which it was designed throughout the course of the repairs with the addition of a few simple safety provisions.

PRECAUTIONS.

The cutting away of concrete which is stressed or under load should be attended by special precautions where such concrete has been included in the design and calculations of the strength of the structure. In the case of beams the super load should be removed, and the beam relieved of any portion of the structural load by propping wherever possible to remove deflection of the member. Some concrete designers do not include any concrete outside the hooped core of stanchions in their calculations, and in such cases the concrete outside the hooping may be cut away without increasing the stresses allowed in the design. Should the whole of the concrete have been included in the design as carrying load, the cutting away of, say, 1 in. all round the column is not a serious matter if the columns are large. If the columns are small in section then this removal of concrete becomes a big proportion of the whole, and some attempt should be made to relieve the column of a proportion of its load.

Stresses in Concrete Column Loaded to 50 Tons.

Take the case of a column 12 in. square, and reinforced by four ¾ in. diameter bars, and stressed to 700 lbs. per sq. in.



Area concrete 12 in. by 12 in. . . . . = 144
,, steel in concrete units 4 × 0·44 × (15 − 1) = 24·6

168·6 concrete units

Load 168·6 × 700 = 118,020 lbs. = 53 tons.

Should 1 in. of concrete be cut away:

Area concrete 10 in. by 10 in. . . . . = 100
,, steel (concrete unit) . . . . . = 24·6
124·6

So that $\frac{\text{load}}{\text{reduced area}} = \frac{118{,}020}{124{\cdot}6} = 950$ lbs. stress per sq. in. or a serious increase on 700 lbs./sq.in.

In some cases it may be necessary to remove more concrete than 1 in., and the remaining concrete would be stressed much higher. The addition of "Gunite" does not relieve the old concrete of any of its stresses, as the "Gunite" does not take up any stress at all unless the reconstructed column is relieved of at least part of its load during repair, and the "Gunite" is then allowed time to mature. If part only of the load is removed from a stanchion under repair the "Gunite" finally takes less stress than the original concrete.

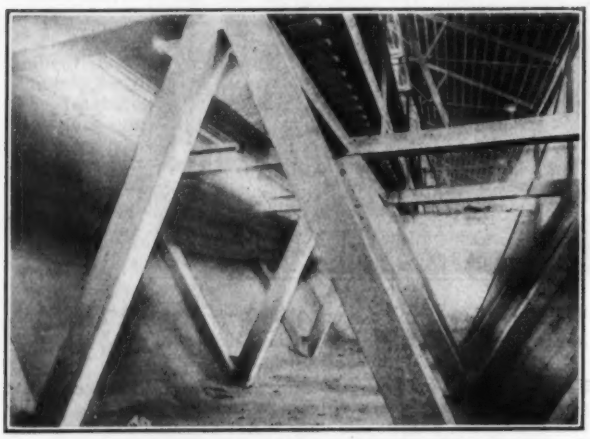


Plate VI.—VIEW OF REPAIRED COAL AND COKE HOPPER.

As an example, if we consider the modulus of "Gunite" is 50% more than the concrete under repair, the respective stresses would be as follows:

Column as before (12 in. by 12 in. reinforced with four ¾ in. dia. bars)...stress 700 lbs. per sq. in. over the whole concrete area will carry a load of 53 tons.

Should 1 in. outer face be removed all round, and the load reduced by half during repair, the load on the remaining core would be:—

$$\frac{26\frac{1}{2} \times 2240}{124{\cdot}6} = 475 \text{ lbs. per sq. in.}$$

Area of "Gunite" = 168·6 − 124·6 = 44 sq. in.

$$\frac{\text{Modulus of "Gunite"}}{\text{Modulus of concrete}} = 1{\cdot}5$$

After reconstruction, and the full load returned, the old concrete would be stressed:—

$$475 + \frac{26\frac{1}{2} \times 2240}{(124{\cdot}6) + (44 \times 1{\cdot}5)} = 475 + 310 = 785 \text{ lbs. per sq. in.}$$

and the stress on the "Gunite":—

$$310 \times 1\tfrac{1}{2} = 465 \text{ lbs. per sq. in.}$$

or to consider total loading:—

Concrete 124·6 × 785 lbs. = 97,500 lbs.
"Gunite" $\frac{44}{168{\cdot}6}$ × 465 lbs. = 20,500 lbs.
118,000 lbs.

or 53 tons as before.

Increasing Strength of Core by Binding.

Although 50% of the loading was removed during repair, the working stress on the old concrete has been increased by 85 lbs. per sq. in. It will be seen, however, that the strength of the old concrete core is increased by addition of the steel mesh used in connection with the "Gunite" repair. This has the effect of increasing the bonding or hooping of the core.

Using a formula adopted by the R.I.B.A. in their Regulations on Reinforced Concrete, and considering the 12 in. column as before—

Where $c\rho$ = working compressive strength of concrete not hooped.
f = factor . . . 1 for spiral bonding.
0·75 ,, circular hoops.
0·5 ,, square or rectangular hoops.
s = spacing factor for 3 in. pitch of hoops = 24
2½ in. ,, ,, = 28
2 in. ,, ,, = 32
vh = cube in inches or volume of hooped reinforcement in 12 in. length of column
v = cube in inches or volume of concrete in hooped core in 12 in. length of column.

$$r = \frac{vh}{v} = \frac{\text{volume of hooped reinforcement}}{\text{volume of hooped core}} = \frac{0{\cdot}93}{120} = 0{\cdot}0078$$

Then working stress on wire meshed core

$$= c\rho\,[1 + fsr] = 700\,[1 + (0{\cdot}5 \times 28 \times 0{\cdot}0078)]$$
$$= 700 \times 1{\cdot}109$$
$$= 776 \text{ lbs. per sq. in.}$$

So that by removing half the load at the time of repair the old concrete core is made sufficiently strong by the addition of the mesh reinforcement to take the extra stress over 700 lbs. required.

Concrete Core Loaded Only.

It is possible that cases may arise where it is quite out of the question to reduce the loading of members during "Gunite" repairs. This means a large increase in the stress of the old core; and binding with laterals at suitable pitch and making good with "Gunite" would give a reasonable factor of safety to such a case. It can be shown by experiment, however, that considerable extra strength is imparted to concrete by a "Gunite" cover even without such provision. Two blocks of poor- or wet-mix concrete of the same mixing were made 3 in. by 3 in. by 8 in. long, and allowed to stand for 16 days. At the same time a hollow case of "Gunite" was made with a centre 3 in. by 3 in., and an outside measurement of 6 in. by 6 in. by 8 in. long by meshing a wood centre, covering in the usual way with "Gunite," and removing the centre after initial setting. The case was also allowed to stand 16 days, and then the specimens were tested as follows:

One block was tested by compression to destruction. The "Gunite" case was well greased inside, and the second block slipped in. Compression was applied to the concrete core only, and was transmitted by means of a block of steel 3 in. by 3 in. by 2 in. deep. The crushing stress test showed as follows:

Concrete block . . . . . 1115 lbs. per sq. in.
Concrete block placed in hollow "Gunite" case . . . . . 3300 ,, ,,

The stress necessary before collapse is thus increased by 3 times.

REPAIRS TO FERRO-CONCRETE GANTRY.

After completion of the work required to the concrete purifier building, repair was commenced on a reinforced concrete gantry supporting an overhead crane track 60 ft. high. See Plates VII., VIII., and IX. In this construc-

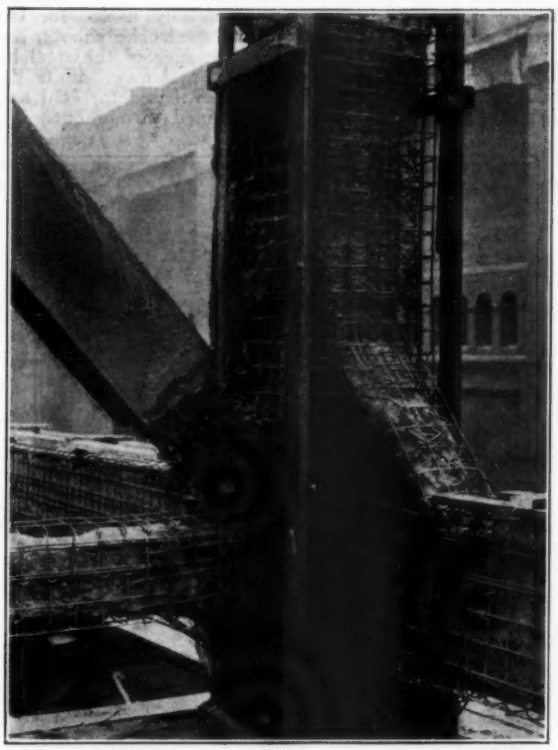


Plate VII.—COKE CRANE GANTRY.

Arrangement of mesh at intersection of beams and stanchion.

tion as many as six concrete members met together at one point in a large number of cases (see Plate VIII.), and we felt that although the efficiency of "Gunite" for strengthening a plain structure could be proved, we would like to satisfy ourselves as to the effectiveness of application to a more complex design. As mentioned before, for "Gunite" to be effective the cover must be applied in

continuity of strength in all directions, especially at joints of members.

Test on Beams and Girders.

A further set of test models was made consisting of ferro-concrete beams and lattice girders. Three beams were made of rectangular section 10 in. by 7 in. by 10 ft. 8 in. long, and three lattice girders—overall length 9 ft. 6 in., height 1 ft. 9 in., cross-section of lateral and diagonal members 3½ in. by 3 in. The reinforcement of the beams consisted of five ½ in. bars with ¼ in. binding at 4 in. centres, and of the girders ½ in. and ⅜ in. steel bars with ⅛ in. binding at 3 in. centres, and all arranged as shown on Sketch IV. The concrete mixture was 4:2:1, aggregate ¾ in. to ¼ in. plain beams, and ⅜ in. to ⅛ in. lattice beams, Leighton Buzzard sand, and ordinary B.S. cement. In each group of beams two were made with poor- or wet-mix concrete of the same mixing, and one with good-mix concrete as before. One wet-mix concrete specimen from each group was chipped down to the steel after one month, and wire meshed and "Gunited." The finished "Gunited" sizes were—beams 10 in. by 7 in., and girders 4 in. by 4½ in. The size of the lattice girder was increased owing to practical difficulties of application. The specimens were tested two months after first casting, and one month after "Gunite" application. The plain beams were supported on pads 10 ft. between inner edge, and the lattice beams were on pads 9 ft. from centre to centre, and both were centrally loaded. Deflection readings were taken at points A, B, and C, but the Deflections at A and C were negligible, so that in both groups the deflection at the centre of the neutral axis only is given. (See Curves II. and III.) The results were as follows:

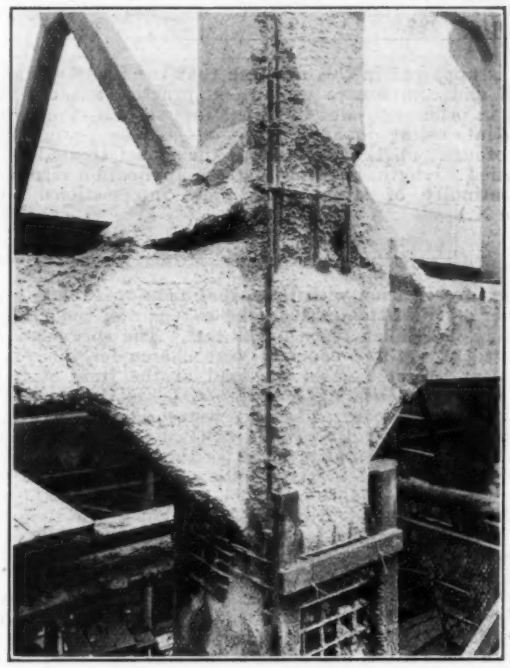


Plate VIII.—COKE CRANE GANTRY.

Instance of deterioration at intersection of beams and stanchion. Note accumulation of excessive aggregate in haunches.

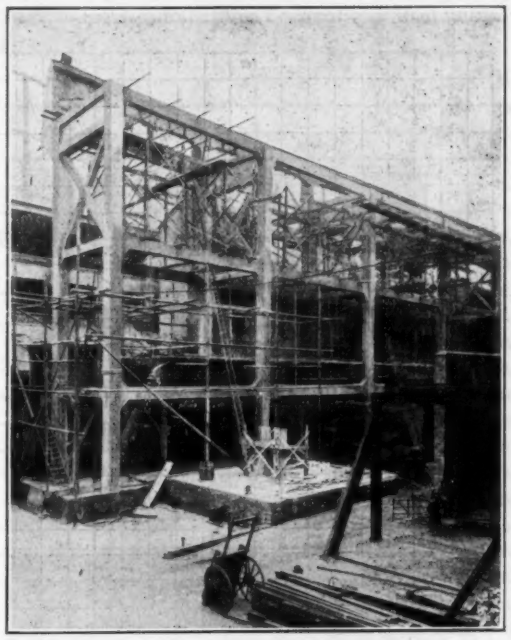
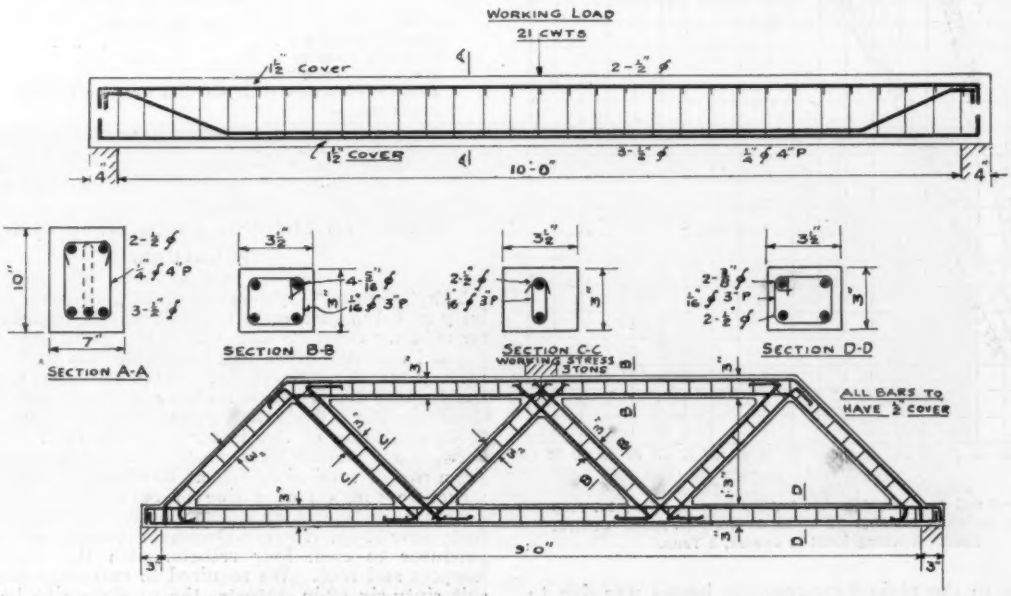


Plate IX.—COKE CRANE GANTRY.

General view, partly finished work.

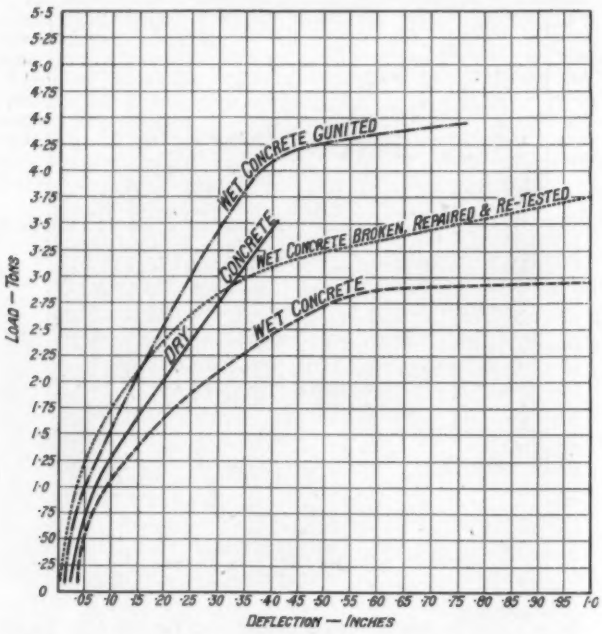
Plain beams—		
Wet-mix concrete	2·85	Tons
Good-mix concrete	3·32	maximum
Wet-mix concrete and "Gunite"	4·42	load
Lattice beams—		
Wet-mix concrete	4·08	Tons
Good-mix concrete	6·75	maximum
Wet-mix concrete and "Gunite"	11·00	load



Sketch IV.—REINFORCEMENT FOR TEST BEAMS AND LATTICE GIRDERS.

It will be noted that the results show satisfactory increases of strength by means of "Gunite" application—the strength again raised higher than good original concrete—and prove that "Gunite" can be applied to cover consistently a more complex design.

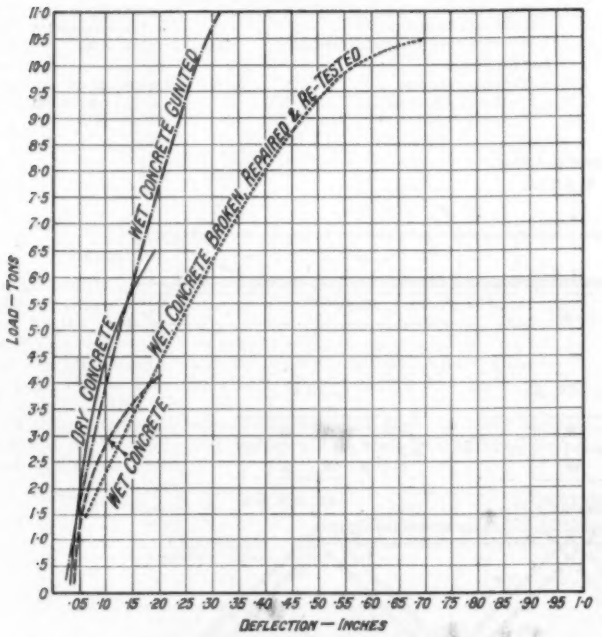
The beams were designed to take a load of 21 cwts. with a breaking load of 4 tons. The breaking stress of the steel



Curve II.—Bend Tests on Concrete Beams, 10 in. by 7 in. by 10 ft. 8 in. long, 10 ft. span, Central Load. Working Load in Centre, 21 Cwts.

would be about 32 tons per sq. in. A calculation of the stresses on sections gives the following:

—	Breaking Load.	Maximum Compression on Concrete.	Maximum Tension in Steel.
	Tons.	Lbs.	Tons.
Wet-mix concrete	2·85	1900	20·5
Good-mix concrete	3·32	2220	23·8
Wet-mix concrete "Gunited"	4·42	2950	31·5



Curve III.—Bend Tests on Concrete Lattice Beams, 1 ft. 9 in. deep by 9 ft. 6 in. long, Members 3 in. by 3½ in., 9 ft. span, Central Load. Working Load in Centre, 3 Tons.

The failure in the plain ferro-concrete beams was due to compression in concrete, and the failure of the "Gunited" specimen was due to tension in steel. Again the beam was strengthened by means of "Gunite" to the full tensile strength of the steel reinforcement.

In the case of the three warren girders the steel would have a similar tensile strength, that is, about 32 tons. The girders were designed for a loading of 3 tons, and breaking load of 12 tons. The stress on sections was as follows:

—	Breaking Load.	Maximum Compression of Concrete in Top Boom.	Maximum Stress on Steel in Bottom Boom.
	Tons.	Lbs.	Tons.
Wet-mix concrete	4·08	600	10·20
Good-mix concrete	6·75	1010	16·8
Wet-mix concrete "Gunited"	11·00	1650	27·5

It is apparent in this instance that the models were too small and complex to produce in practice a satisfactory joint in ordinary concrete at the intersection of members. It is interesting to note that the "Gunite" application has brought up the strength of the model treated to the designed strength, showing that the application resulted in a continuity of strength at these intersections. (See Plate X.)

"Gunite" Repair of Fractured Specimen.

The investigation with these specimens was taken a step further by an attempt to make a repair of models after fracture had taken place under test. The specimens constructed of wet-mix concrete were chosen for this experiment, as in these cases the load at the time of failure had not approached the breaking stress of the steel.

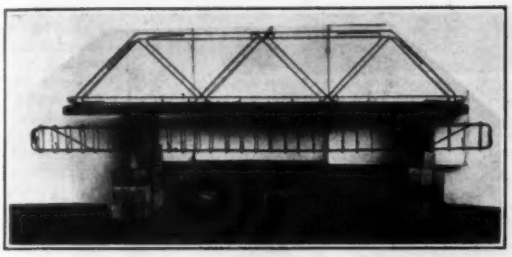
The wet-mix beam and girder were taken from the testing machine, and all loose and cracked concrete cut away. This involved a complete break in the construction of the concrete for about a foot in length where failure had occurred, while at this point a bend occurred in the steel reinforcement thus laid bare. The bends in the steel were first straightened out, and then the concrete on the remainder of the specimens was chipped bare to the steel reinforcement, leaving a core of concrete to the limits of the steel. A core of concrete was then built within the steel in the positions where the whole of the concrete had been removed. A mesh was laced outside the bars in these cases, extending either side past the fracture, and some strips of wood introduced into the centre of the beam between the steel bars. "Gunite" was then filled in against this wood to the thickness of half the core. After initial setting the wood strips were removed, and "Gunite" was then filled in against the first filling until the core was completed just larger than the limits of the steel reinforcement. The test piece was then again meshed all over, and "Gunited" in the usual way. After standing a month, the specimens were tested. The results are given, and for simple omparison the breaking loads of the original tests are repeated.

	Breaking Load. Tons.
Beams—	
Wet-mix concrete	2·85
Good-mix concrete	3·32
Wet-mix concrete "Gunited"	4·42
Above wet-mix concrete repaired after test and re-tested	3·95
Lattice beams—	
Wet-mix concrete	4·08
Good-mix concrete	6·75
Wet-mix concrete "Gunited"	11·00
Above wet-mix concrete repaired after test and re-tested	10·35

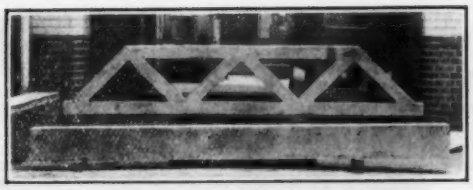
INCREASED LOADING TO EXISTING CONCRETE STRUCTURE.

The "Gunite" system of placing concrete is particularly useful in such cases where it may be desired to extend an existing concrete structure. The points of junction of the old and new work can be coupled up in a very satisfactory manner. Similarly, it may be desired to increase the loading for which a building was originally designed, involving the introduction of extra steel reinforcement.

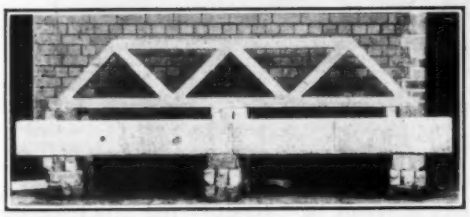
An alteration of this latter type has been satisfactorily carried out on the ferro-concrete superstructure supporting a row of vertical retorts at Windsor Street. The superstructure consists of a line of columns 15 ft. high connected by haunches and beams, and was designed to carry forty-four 57-in. Woodall-Duckham retorts, and an internal producer to each four retorts, with the necessary coal hoppers and roof. We required to rearrange the bench to suit sixty-six 62-in. retorts, the producers to be external. In the original design the spacing of the columns was so



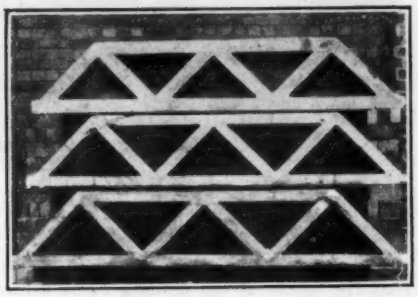
Steel Reinforcement.



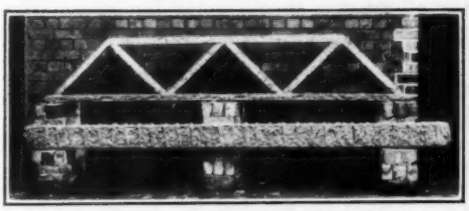
"Gunited" Girder and Beam.



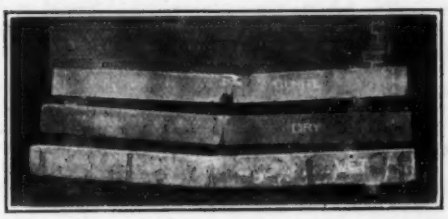
Cast Girder and Beam.



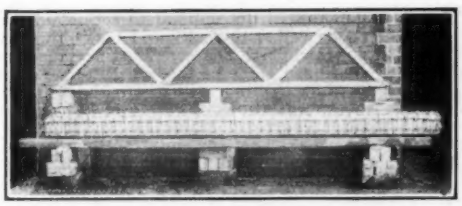
Girders after Testing



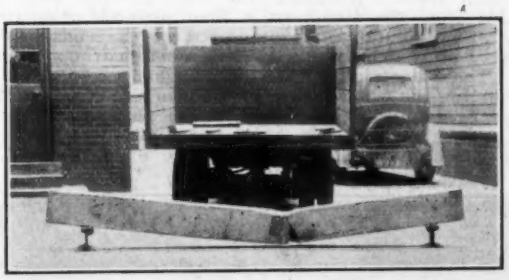
Stripped for "Guniting."



Beams after Testing.



Meshed for "Guniting."
PLATE X. (*a*).



Wet Concrete Beam Broken under Test, Repaired and Re-tested.
PLATE X. (*b*).

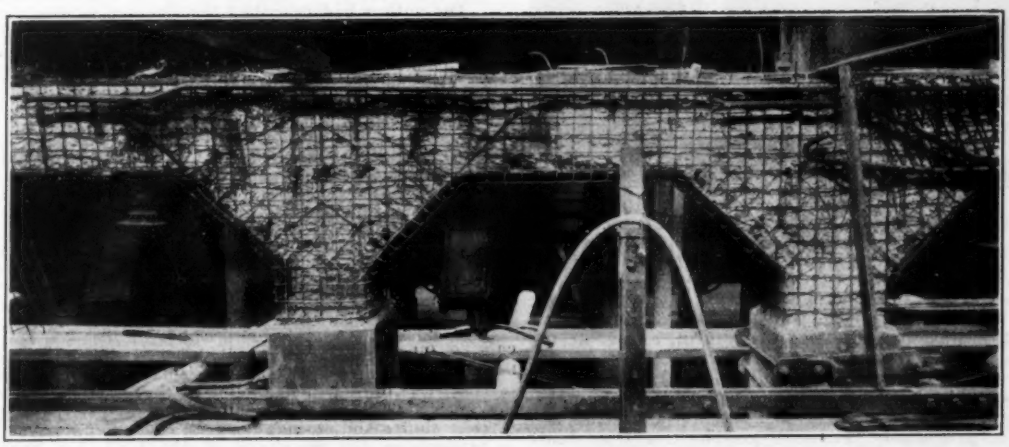


Plate XI.—VERTICAL RETORT SUBSTRUCTURE.

Showing beams and haunches cut back to existing reinforcement and mesh placed.

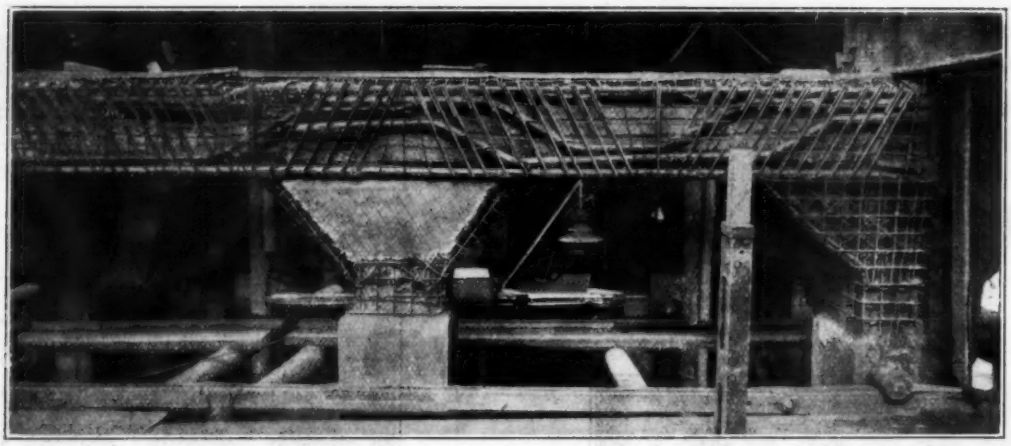


Plate XII.—VERTICAL RETORT SUBSTRUCTURE.

Showing first panel of "Gunite" and new steel in position with cross wires to stirrups.

arranged that the whole of the loading came directly over the haunches and columns, and the connecting beams contained little reinforcement, acting as tie beams only. With the new reconstruction the total loading was not greatly different, but it was necessary to place weight on the beams. The beams thus required additional reinforcement. A certain amount of repair was also required to the structure, and a number of the columns had settled out of plumb.

The columns were brought to the vertical by arrangement of wire mesh and shuttering, and the suitable placement of "Gunite." The concrete cover over the existing reinforcement of the haunches and beams was removed back to the steel, and a mesh fixed round the members. Ties of $\frac{3}{8}$-in. steel were made from the existing reinforcement to this mesh, and ties were also left every 1 ft. 6 in. for attachment to the new bars to be introduced later. A panel of "Gunite" was then placed on the sides, as shown on Plates XI. and XII. The new steel reinforcement was then fixed. Although the settings had been dismantled from the structure, a floor joist remained over every other column, and supported at the ends a steel buckstay or stanchion carrying the steel coal hoppers and roof. These floor joists were placed upon a 6 in. by 1 in. flat running the whole length of the concrete beam, so that it was necessary to leave this flat in position while the work was carried out. In order to maintain continuity of lateral strength the new steel was tied by means of $\frac{1}{4}$-in.

Plate XIII.—VERTICAL RETORT SUBSTRUCTURE.

Finished "Gunited" beams and haunches.

rods running under this flat every 1 ft. 6 in., and staggering with the ties left from the existing reinforcement. The new steel was therefore tied every 9 in. along the top of the beam, and similar ties were arranged under the beam between the haunches. (See Plate XII.) Longitudinal $\frac{3}{8}$-in. wires were fixed to the stirrups of the new reinforcement to provide a key, and a covering of "Gunite" placed. The progress of this work may be seen from Plate XIII., and an excellent job was made.

It is apparent that our early experience of concrete structures has been a most unfortunate one, and that the possibility of repair by "Gunite" has saved the Birmingham Gas Department a very considerable outlay in reconstruction. I should make it clear, however, that a large amount of concrete building has been added to the works since the war, and that no serious defects have arisen in connection with this later construction. Our faith in the efficiency of concrete in gas-works for certain structures is therefore unimpaired, as we now realize the reasons for the failure of the earlier concrete.

In conclusion, I beg to thank the Birmingham Gas Committee and Mr. A. W. Smith, the General Manager of the Department, for permission to give this Paper. I am also indebted to Dr. C. M. Walter and his Assistants for the testing, and to Mr. Hale, of Messrs. The Birmingham Concrete Steel Company, for introducing the system of "Gunite" repairs to me, and for further kindly advice; also to Messrs. The Cement-Gun Company (Great Britain), Limited, who carried out the first repair work at Windsor Street.

Discussion.

The PRESIDENT said that it did not fall to the lot of the average gas engineer to be called upon to undertake the extensive special repair work which Mr. Pearson had described so ably. The author had mentioned some of the causes of deterioration. It had occurred to him that in cases where the reinforcement had insufficient cover, variations in atmospheric temperature would cause a greater degree of expansion and contraction in the steel-reinforcement, thus setting up strains and causing deterioration of the concrete. Mr. Pearson had also mentioned that all concrete was permeable. This would suggest that for all structures which were subject to corrosive influences—for example, the supporting columns of overhead purifiers—additional concrete cover might be given to the reinforcing material, and, further, that permeability might be reduced by the occasional application of a good cement wash. It would be interesting to hear Mr. Pearson's views on this point, also whether he had any experience of the use of silicate of soda as a waterproof protective coating. Did he consider that the Gunite formed an impermeable protective coating to the old concrete work?

The author had described the cleaning process necessary before the application of Gunite. He would be glad if Mr. Pearson could tell them whether it was necessary to moisten the prepared work before the Gunite was applied. Had the author any experience of the deterioration of underground reinforced concrete?

PREVENTION BETTER THAN CURE.

Mr. HAROLD DAVIES (Chesterfield) remarked that anyone who had had experience of such work knew the amount of attention and supervision which had to be given to repairs. He believed that prevention was better than cure. Thirty years ago he put up a structure of concrete and it was standing to-day. He would like to ask whether it was that the use of sand was to some extent the cause of permeability, because in the structure he put up he used granite, and it was as good to-day as when erected.

Mr. C. H. CARDER said he had had considerable experience with the type of repairs with which Mr. Pearson had been dealing, and he could endorse all that was claimed for the method. One of the important points which Mr. Pearson rightly emphasized was the particular value of the great density of concrete imparted to the body, especially for such purposes as re-lining coke chutes and storage hoppers. This density was largely dependent on the cleanliness of the sand, the fineness of the cement, and the use of the minimum amount of water, as well as the velocity of impact. This was the point where the skill

of the operator counted most, as the regulation of the water flow was not automatic. He congratulated Mr. Pearson on the fact that by the careful selection and preparation of material he reached the phenomenally high compression strength of 10,000 lbs. They thought, said the speaker, that 6800 lbs. was pretty good, and this gave excellent results in wearing qualities.

Another purpose for which Gunite could be used, where the density was of particular value was in the lining of circular steel purifiers, a form of construction not widely used in this country, although it enabled the greatest advantage to be taken of the tensile strength of the steel, and relatively light plate could be used for boxes of large capacity.

The practical experiments carried out by Dr. Walter and his staff on the lattice girders were most interesting, and the figures of breaking stresses and deflection under load which were obtained would be not only of interest but of use in considering variations in the degree of reinforcement customarily adopted under certain conditions, so as to take full advantage of the tensile strength of the steel and to balance the stresses between the steel and the concrete. The importance of the correct proportioning of the water content of the concrete was again emphasized by these tests. Mr. Pearson rightly stressed that the full benefit of structural repair to concrete stanchions was not obtained unless the load on the column was fully relieved during the progress of the repair. A part of the increased strength provided by the loose sleeve was, of course, due to the tensional stresses taken up by the steel mesh—a point which applied in a slight degree also to the test block of which details were given by the author.

Cost of Gunite Repairs.

Mr. E. B. Tomlinson (Birmingham) spoke of the conditions under which the work was carried out. All their best workmen were at the front, and the work had to be done when their knowledge of ferro-concrete was limited compared with what it was to-day. The men available were not used to the type of work. He pointed out that if the Gunite method or some similar method had not been available it would have meant putting the buildings out of commission and of suspending work in them, so that it would have been almost impossible to carry on the gas-works. And, of course, to demolish these buildings and rebuild them in steel would have been a very serious matter. The cost of Gunite repairs had been about one-fifth of the original cost of the structures dealt with, and as the original strength of the buildings had been restored, even if it was not increased, he felt that it was an economical expenditure.

Mr. A. W. Smith (Birmingham) said the paper gave but a slight indication of the anxious time Mr. Pearson had been through. The experience of deterioration was not peculiar to their own works, but he was astonished to find that it was widespread. In a conversation with one of the officials of the Ministry of Health he found there had been similar experiences in many parts of the country, and abroad as well. One saw apparently perfect stanchions and beams, and it was not until one began to hammer them that they began to break off. He did not think any one was to blame for this. It was an unfortunate set of circumstances, because they were forced on to concrete as steel was not available and the right type of workman also was not available. An investigation had also been made to ascertain if gas-works atmosphere caused intensive deterioration, but they came to the conclusion that the causes were those Mr. Pearson had mentioned.

Painting Concrete Structures.

Mr. H. M. Hale said he was a reinforced concrete engineer and had had a lot to do with repair of concrete structures. He was afraid deterioration was more widespread than was generally realized. In his youth he was taught they would last for ever, but experience had shown that unless certain precautions were taken reinforced concrete would not last for more than 15 or 20 years without heavy maintenance charges. Mr. Pearson had mentioned five causes of deterioration; they were the principal causes, but there were others, such as leaky shuttering, unsuitable materials, high tensile stresses in the design, and competitive design. The atmosphere of large towns was very destructive to concrete and other buildings, and where concrete work was situated in very smoky places engineers would be well advised to consider painting with some of the paints advertised for concrete. He thought there was going to be a great future for them.

Mr. H. Jackson (Hall and Jackson, Birmingham) remarked that as an engineer he admired the way in which Mr. Pearson handled this problem. The speaker referred to the importance of the quality of materials and suggested that at the time in question there was perhaps a desire to hurry the structures. Those who had the placing of orders might very well consider the fact that an increase of 5, 10, or even 20% in the building time might represent a saving in the long run.

Alderman J. H. Lloyd (Chairman of the Birmingham Gas Committee) agreed as to the anxiety which Mr. Pearson and Mr. Tomlinson must have had; the Committee had also had an anxious time. It was an advantage to see the difficulties and the failures as well as the successes. He had seen a little of this in regard to water, and he admired their frankness and wisdom in putting their cards on the table, and letting other engineers see some of the problems and how they overcame them.

Mr. R. J. Milbourne said he thought that, particularly in engineering, they learnt more from failures than successes, and for that reason alone the Gas Industry was greatly indebted to the Birmingham Committee and their engineers for bringing this subject forward. They were also to be congratulated on having the skill to tackle such a difficult job.

Mr. N. E. Green said that from the discussion it might be thought that concrete was very difficult to deal with, but often it was due to a lack of knowledge and a lack of confidence and not putting the work under a skilled engineer. He believed much trouble could be avoided if consistent tests were made from time to time, and he would recommend that concrete sand and aggregate be submitted to competent testing houses. Cement did not require a great deal of testing when it was obtained from reputable firms, but it could be spoilt by over watering, dirty sand, and dirty aggregate. As far as maintenance of buildings was concerned he was in favour of every structure being closely examined at least every five years, and if necessary a protective coat of paint should be given. In the future there might be a tendency to try something in the nature of a rubber solution.

The Author's Reply.

Mr. Pearson agreed as to the importance of cover, and said that in the new shed they put down in 1926 they allowed 2 in. of cover on the stanchions and 1½ in. on the beams. He did not think much about cement wash, as they had used many gallons at Windsor Street, and the effect of these proofers seemed to be to cause the surface of the concrete to crumble. It might be that it was poor concrete in the first instance. In reply to Mr. Poulson, he thought he was right in saying all concrete was permeable, but Gunite was probably denser than ordinary concrete. As to the application of water, the procedure was to blow the surface with air and wash it down with water at pressure. In the buildings at Windsor Street there was no underground reinforcement.

Vote of Thanks.

The President said he was sure that it was their wish that a hearty vote of thanks be accorded to Mr. Pearson. On reading Mr. Pearson's paper the thought occurred to him that the defects of the early work were really a blessing in disguise, because if these defects had not appeared, such a process as Gunite might not have been used at Windsor Street, and consequently the engineering feat—and he submitted that it was an engineering feat—of strengthening the retort structure might not have been attempted.

The paper was packed with information from which most of them might learn something, and the careful thought, infinite patience, and dogged perseverance which Mr. Pearson had displayed in this work was surely very creditable to himself and a lesson to all of them.

Mr. C. M. D. Belton (Shrewsbury), in seconding, congratulated Mr. Pearson on the frank manner in which he had put the facts before them.

Mr. Pearson briefly replied.

Annual Meeting of the Co-Partners of the Watford and St. Albans Gas Company.

The Twenty-Fourth Annual General Meeting of co-partners of the Watford and St. Albans Gas Company was held on Oct. 12, 1933, at the Gas Company's Chief Showrooms, Watford. Mr. Frank H. Jones (Chairman and Managing Director) presided.

Mr. Frank H. Jones welcomed the co-partners from Welwyn, Hatfield, and Harpenden, and intimated that he hoped he would be able to extend a welcome next year to the Rickmansworth employees. He was very pleased to note that £1000 had been voluntarily deposited by employees in their scheme during the year. Bonus had been paid on the usual basis to all members, and the stock that had been allocated to employees since the inception of the fund now amounted to £20,000. Gas stocks, he continued, were greatly in favour throughout the country, and their own ordinary stock was quoted at £150 for £100 nominal.

The employees, he said, were doubly co-partners, as recipients of bonus each half-year and of stock from time to time, and they should remember that unless they always placed the consumer first, it would be impossible for the Directors to give them the advantages as they now had. Each workman was a potential salesman, and should see that the Company's consumers received the highest possible service. Bonus was a reward for that little bit extra done by the employees, the result of that little bit extra being shared by consumer, shareholder, and co-partner.

Reference was made to the first issue of *The Co-Partner*, the official magazine of the Company [referred to in the "Journal" recently], and the Chairman asked that everyone should purchase the future issues, and should forward to the Editor any contributions in the way of articles, &c., to make the journal the success it deserved. Mr. Jones referred to the Centenary Celebrations to be held early next year, and remarked that they should feel proud of the great traditions of the Company, which now provided work for over 650 employees and had a capital of more than a million pounds.

An announcement of the raising of the men's bonus from 3% to 5% was accorded much applause.

Mr. Henry Brown (Deputy Chairman) referred to the healthy state of the co-partnership and pension fund accounts, and drew attention to the splendid collections of £178 11s. 5d., made for the local hospitals and various charities.

GAS MARKETS & MANUFACTURES

Stock Market Report.

[For Stock and Share List, see later page.]

Despite the uncertainty as regards the American monetary policy, markets last week were steady, and an appreciable volume of business was transacted. The features of the week were the continued strong support of British Government securities and the marked success of yet another Empire issue—that by the Government of Southern Rhodesia. Dominion stocks are becoming increasingly popular as the credit position of the countries improves, and all the recent new issues now stand at a premium.

Gas stocks and shares maintained a firm tone and upward price movements continued to take place. A sharp rise of 11 points occurred in Oriental ordinary to 127½. This Company's accounts are not yet published, but the increase indicates a successful year and the possibility of an improved dividend. Among other improvements South Suburban ordinary rose 3 to 132½ and Tottenham 5½% preference a similar amount to 126½. South Metropolitan ordinary hardened 1 to 134½, business being done at 136, at which price a parcel of this stock is on offer, and, on the basis of a 6% dividend, the yield is £4 8s. 2d.%.

At the time of writing the ordinary stocks available include £1600 British at 163, yielding £4 12s.; £2500 European at 135, which on a dividend of 6%, free of tax, yields £5 18s. 6d.; and £6000 South Shields consolidated at 177½, giving a return of £4 15s. 9d.%. Among preference stocks a parcel of £10,000 South Metropolitan 4% is on offer at 103½, yielding £3 17s. 3d.%. In the debenture list £18,000 Mid-Southern Utility 4% is offered at 105, free of stamp duty, yielding £3 16s. 2d.—two months' interest is payable on Jan. 1. A few small parcels of perpetual debenture stocks are also available at prices yielding 4% or a trifle over, among which are the following: £200 North Middlesex 5% at 121, £415 Oxford 5% at 120, £300 Tunbridge Wells 5½% at 132, and £200 Wellington (Salop) 5% at 117.

Current Sales of Gas Products.

The London Market for Tar Products.

LONDON, *Oct.* 30.

The market for tar products remains practically unchanged.

Pitch is quoted at about 77s. 6d. per ton f.o.b.

Creosote continues firm at 3d. to 3¼d. per gallon.

Refined tar is 4d. to 4¼d. per gallon in bulk at makers' works.

Pure toluole is about 3s.; pure benzole, 1s. 9d.; solvent naphtha, 95/160, is steady at 1s. 8d.; and 90/140 pyridine bases, about 4s. 6d.—all per gallon naked at makers' works.

Tar Products in the Provinces.

Oct. 30.

The average prices of gas-works products during the week were: Gas-works tar, 30s. to 35s. Pitch—East Coast, 72s. 6d. to 75s. f.o.b. West Coast—Manchester, Liverpool, Clyde, 72s. 6d. to 75s.* Toluole, naked, North, 2s. to 2s. 2d. Coal-tar crude naphtha, in bulk, North, 6d. to 6¼d. Solvent naphtha, naked, North, 1s. 6¼d. to 1s. 7d. Heavy naphtha, North, 10d. to 11d. Creosote, *ex* works, in bulk, North, liquid and salty, 2d. to 2¼d.; low gravity, 2d.; Scotland, 2d. to 2¼d. Heavy oils, in bulk, North, 4d. to 4¼d. Carbolic acid, 60's, 2s. 6d. to 2s. 7d. Naphthalene, £9 to £10. Salts, 55s. to 75s., bags included. Anthracene, "A" quality, 2½d. per minimum 40%, purely nominal; "B" quality, unsalable.

* All prices for pitch are now quoted on the basis of f.o.b. In order to arrive at the f.a.s. value at any port it will be necessary to deduct the loading costs and the tolls whatever they may be.

Tar Products in Scotland.

GLASGOW, *Oct.* 28.

No material alteration has taken place in market conditions during the week. Prices are fairly steady, but there is not a great deal of buying interest.

Crude gas-works tar.—The actual value is a fraction lower at 40s. to 42s. per ton *ex* works.

Pitch.—Business is reported to have been done on a very keen basis, but makers' quotations remain at round 67s. 6d. to 70s. per ton f.o.b. Glasgow, according to quantity. The home value is unchanged at 70s. per ton *ex* works in bulk.

Refined tar to Ministry of Transport specification is valued at 3⅛d. to 3⅜d. per gallon f.o.r. in buyers' packages, for prompt and forward delivery.

Creosote oil.—Prompt supplies continue quite scarce, and prices are firm as follows: B.E.S.A. specification is 3d. to 3⅛d. per gallon; low gravity, 3d. to 3⅛d. per gallon; and neutral oil, 3⅛d. to 3⅜d. per gallon—all in bulk *ex* works.

Cresylic acid.—There is not much new business being arranged, but prices remain fairly steady as follows: Pale, 97/99%, is 11d. to 1s. per gallon; dark, 97/99%, 9d. to 10d. per gallon; and pale, 99/100%, 1s. 2½d. to 1s. 3½d. per gallon—all f.o.r. in buyers' packages.

Crude naphtha is only available in small quantities at 4½d. to 5d. per gallon *ex* works in bulk, according to quality and quantity.

Solvent naphtha.—Value of 90/160 grade is higher at 1s. 5d. per gallon, supplies being very scarce. 90/190 heavy naphtha is still available at 1s. per gallon.

Motor benzole now commands 1s. 6d. per gallon *ex* works; but prompt supplies are still difficult to secure.

Pyridines.—90/160 grade is 3s. 3d. to 3s. 6d. per gallon, and 90/140 grade 3s. 6d. to 3s. 9d. per gallon.

Benzole Prices.

These are considered to be the market prices for benzole at the present time:

	s. d.		s. d.	
Crude benzole	0 9	to	0 9½	per gallon at works
Motor ,,	1 4	,,	1 4½	,, ,, ,,
Pure ,,	1 7½	,,	1 8	,, ,, ,,

Gas Acts (1920 and 1929) Orders.

SPECIAL ORDERS.

Barnstaple Gas Company.

Application is being made by the Company for an Order to enable them to raise additional capital, to prescribe a sliding-scale, and to make other provisions with reference to the Company's affairs.

Metropolitan Gas Companies' Testings.

The Gas Referees' report on the official testings for the past quarter gives the following average calorific values for the gas supplied by the Metropolitan Companies named:

Commercial Gas Company.—503·9 B.Th.U. (declared calorific value, 500 B.Th.U.).

Gas Light and Coke Company.—502·1 B.Th.U. (declared calorific value, 500 B.Th.U.).

South Metropolitan Gas Company.—561·5 B.Th.U. (declared calorific value, 560 B.Th.U.).

South Suburban Gas Company.—562·1 B.Th.U. (declared calorific value, 560 B.Th.U.).

Tottenham and District Gas Company.—500·7 B.Th.U. (declared calorific value, 500 B.Th.U.).

Wandsworth and District Gas Company.—504·4 B.Th.U. (declared calorific value, 500 B.Th.U.).

Corporation Undertakings' Results.

Chesterfield.

The accounts of Chesterfield Gas Undertaking show that the net profits for the past year were £683, but the gross profit (less debt redemption and income-tax charges) equalled £10,678, giving a commercial return on the net loan debt of 7¾%. The total reserve of the Undertaking is £13,134.

STOCK AND SHARE LIST.

Official Quotations on the London and Provincial Stock Exchanges.

Issue. £	Share.	When ex-Dividend.	Dividends. Prev. Hf.-Yr. % p.a.	Dividends. Last Hf.-Yr. % p.a.	NAME.	Quotations Oct. 28. (Provincial Exchanges Oct. 27.)	Rise or Fall on Week.	Transactions. Lowest and Highest Prices During the Week.
1,551,868	Stk.	Oct. 9	7	7	Alliance & Dublin Ord. ...	190—180	...	...
374,000	..	July 10	4	4	Do. 4 p.c. Deb. ...	85—95	...	...
567,655	..	Aug. 28	7	7	Barnet Ord. 7 p.c.	165—170	...	169½
300,000	1	Oct. 23	1/9⅔	1/4⅓	Bombay, Ltd.	26/—27/-*	—/6	27/3—27/6
178,280	Stk.	Aug. 14	9½	9½	Bournemouth sliding scale	193—202	...	...
550,050	..	..	7	7	Do. 7 p.c. max. ...	163—168	...	164—166
439,160	..	..	6	6	Do. 6 p.c. Pref. ...	135—140	...	...
50,000	..	June 26	3	3	Do. 3 p.c. Deb. ...	74—79	...	...
162,025	..	..	4	4	Do. 4 p.c. Deb. ...	100—105	...	104½
210,000	..	..	5	5	Do. 5 p.c. Deb. ...	120—126	...	...
357,900	..	Aug. 28	7½	7½	Brighton, &c. 6 p.c. Con. ...	160—170	...	165—167
540,000	..	..	6½	6½	Do. 5 p.c. Con. ...	144—149	...	146—150
195,500	..	..	6	6	Do. 6 p.c. B Pref.	135—140	+1	140
1,487,500	..	July 24	5	5	Bristol 5 p.c. max.	112½—113½*a*	...	...
120,420	..	June 26	4	4	Do. 1st 4 p.c. Deb. ...	99—101*a*	...	...
217,870	..	..	4	4	Do. 2nd 4 p.c. Deb. ...	99—100*a*	...	...
328,790	..	..	5	5	Do. 5 p.c. Deb.	121—123*a*	...	...
855,000	..	Sept. 25	8	7	British Ord.	169—164	+1	160
100,000	..	June 26	7	7	Do. 7 p.c. Pref.	147—152	+2	149—151
350,000	..	..	5½	5½	Do. 5½ p.c. Pref. ...	108—113	...	...
120,000	..	..	4	4	Do. 4 p.c. Red. Deb. ...	94—99	...	...
450,000	..	..	5	5	Do. 5 p.c. Red. Deb. ...	103—113	...	...
160,000	..	June 26	5	5	Cambridge 5 p.c. Deb. ...	115—120	...	...
100,000	10	May 22	6	4	Cape Town, Ltd.	7—8	...	...
100,000	10	Apl. 24	4½	4½	Do. 4½ p.c. Pref. ...	7—8	...	...
150,000	Stk.	June 26	4½	4½	Do. 4½ p.c. Deb. ...	95—100	...	...
626,860	..	July 24	6	6	Cardiff Con. Ord.	117—122	...	...
237,860	..	June 26	5	5	Do. 5 p.c. Red. Deb.	105—110	...	...
157,150	..	Aug. 14	6½	5	Chester 5 p.c. Ord.	105—110*b*	...	...
98,986	1	Oct. 9	2/-	2/-	Colombo, Ltd. Ord....	1⅝—1⅞	...	3/3
24,500	1	..	1/4⅓	1/4⅓	Do. 7 p.c. Pref. ...	18/6—20/6	...	...
609,204	1	Oct. 9	/11·48	/11·48	Colonial Gas Assn. Ltd. Ord.	17/6—20/-	...	...
296,053	1	..	1/3·30	1/3·30	Do. 8 p.c. Pref.	22/—24/-	...	...
1,796,965	Stk.	July 24	6½	5	Commercial Ord.	120—125	...	121½—123
475,000	..	June 12	3	3	Do. 3 p.c. Deb. ...	75—80	...	77½—78
265,272	..	Mar. 6	—	5	Do. 5 p.c. Deb. ...	120—125	...	122
807,560	..	Aug. 14	7	7	Croydon sliding scale ...	147—152	...	...
469,590	..	..	5	5	Do. max. div.	103—108	...	106½—108
500,000	..	July 10	5	5	Do. 5 p.c. Deb.	120—125	...	...
542,270	..	Mar. 6	7	10	Derby Con.	170—180*c*	...	...
55,000	..	July 10	4	4	Do. 4 p.c. Deb.	93—98*c*	...	...
209,000	..	Aug. 28	5	5	East Hull Ord. 5 p.c. ...	108—113	...	...
179,500	..	Aug. 28	6	6	East Surrey Ord. 5 p.c. ...	127—132	...	...
155,019	..	June 26	5	5	Do. 5 p.c. Deb. ...	117—122	...	...
1,002,180	..	Sept 25	17	15	European, Ltd.	130—140	—5	130—132½
19,378,992	..	Aug. 14	5⅝	5⅝	Gas Light & Coke 4 p.c. Ord.	27/6—28/6*f*	...	28/—28/4½
2,600,000	..	..	8½	8½	Do. 8½ p.c. max.	85—88	...	86½—87½
4,477,106	..	..	4	4	Do. 4 p.c. Con. Pref. ...	101—104	...	102½—103½
6,102,497	..	June 12	3	3	Do. 3 p.c. Con. Deb. ...	81—84	...	81½—84
3,642,770	..	..	5	5	Do. 5 p.c. Red. Deb. ...	115—118	...	116½—117½
3,500,000	..	..	4½	4½	Do. 4½ p.c. Red. Deb. ...	112—116	...	113½—115
270,466	..	Aug. 28	6	6	Harrogate New Cons. ...	120—125	...	...
82,500	..	Aug. 28	7	7	Hastings & St. L. 5 p.c. Conv.	143—148	+2	...
258,740	..	..	5½	5½	Do. 5½ p.c. Conv.	111—116	...	...
140,000	1	Oct. 9	†10	1/7½	Hongkong & China, Ltd. ...	31/— 33/-	...	31/3—31/10½
218,200	Stk.	Aug. 14	6	6	Hornsey Con. 5½ p.c. ...	120—125	...	...
5,600,000	..	May 22	10	14	Imperial Continental Cap.	205—215	...	204—214
223,130	..	Aug. 14	3½	3½	Do. 3½ p.c. Red. Deb.	90—95	+½	92½
235,242	..	Aug. 14	8½	8½	Lea Bridge 5 p.c. Ord. ...	167—172	...	...
2,145,907	..	Aug. 14	6	6	Liverpool 5 p.c. Ord. ...	130½—132½*b*	...	...
245,500	..	June 26	5	5	Do. 5 p.c. Red. Pref. ...	103—113*b*	...	...
306,083	..	July 17	4	4	Do. 4 p.c. Deb. ...	99½—101½*b*	...	...
165,736	..	Aug. 28	10	8	Maidstone 5 p.c. Cap. ...	180—190	...	...
56,176	..	July 10	3	3	Do. 3 p.c. Deb. ...	69—74	...	...
75,000	5	June 12	†10	†10	Malta & Mediterranean ...	9—11	...	...
392,000	—	Oct. 2	5½	5½	Metropolitan (of Melbourne) 5½ p.c. Red. Deb.	98—103	...	...
281,978	Stk.	Aug. 28	5	5	M. S. Utility "C." Cons. ...	111—116	...	113—114½
818,657	..	..	4	4	Do. 4 p.c. Cons. Pref.	92—97	...	...
112,126	..	June 26	4	4	Do. 4 p.c. Deb. ...	100—105	...	105
148,955	..	..	5	5	Do. 5 p.c. Deb. ...	118—118	...	...
675,000	..	21 May '31	16	16	Montevideo, Ltd.	62—72	...	69—70
2,061,315	..	Aug. 14	5½	5	Newcastle & Gateshead Con.	25/3—26/3*d*	+·/3	...
682,856	..	..	4	4	Do. 4 p.c. Pref. ...	99—101*d*	...	...
776,706	..	July 10	3½	3½	Do. 3½ p.c. Deb. ...	91—93*d*	...	...
277,285	..	May 8	5	5	Do. 5 p.c. Deb. '48...	107—109*d*	...	...
274,000	..	Aug. 14	5	5	Newport (Mon.) 5 p.c. max.	100—102*a*	...	...
204,940	..	Aug. 28	7½	7½	North Middlesex 5 p.c. Con.	153—158	...	...
396,160	..	Aug. 14	5	5	Northampton 5 p.c. max. ...	101—106	...	...
300,000	..	Apl. 24	9	7	Oriental, Ltd.	125—130	+11	...
316,617	..	June 26	8	8	Plym'th & Stonehouse 5 p.c.	167—172	...	171
504,416	..	Aug. 28	8	8	Portsm'th Con. Stk. 4 p.c. Std.	162—167	...	...
241,446	..	..	5	5	Do. 5 p.c. max. ...	102—107	...	...
114,000	..	Aug. 14	5	5	Preston 5 p.c. Pref.	101—106	...	108
686,312	..	July 24	4	4	Primitiva 4 p.c. Rd. Db. 1911	84—93	+2	...
389,813	..	June 26	4	4	Do. 4 p.c. Cons. Deb.	98—98	+6	85—87
150,000	10	Sept. 25	6	6	San Paulo 6 p.c. Pref. ...	6¼—7¼	...	6⅞
1,736,968	Stk.	Sept. 11	6	6	Sheffield Cons.	129—133*e*	...	...
95,000	..	July 10	4	4	Do. 4 p.c. Deb.	90—94*e*	...	...
133,201	..	Sept. 11	5	8½	Shrewsbury 5 p.c. Ord. ...	132—137	...	...
90,000	10	June 12	15	14	South African	3—5	...	...
6,709,895	Stk.	Aug. 14	7	5	South Met. Ord.	133—136	+1	133—136
1,135,812	..	..	6	6	Do. 6 p.c. Irred. Pf.	135—140	...	139
850,000	..	..	20/-*g*	4	Do. 4 p.c. Irred. Pf.	101—104	+1	102½—105½
1,895,445	..	July 10	3	3	Do. 3 p.c. Deb. ...	80—83	...	81½
1 000,000	..	July 24	5	5	Do. 5 p.c. Red. Deb.	112—116	...	...
209,820	..	Aug. 14	8½	8½	South Shields Con.	171—173*d*	...	...
1,543,795	..	Aug. 14	6	6	South Suburban Ord. 5 p.c.	130—135	+3	129—131
300,000	..	..	5	5	Do. 5 p.c. Pref.	112—117	...	115
300,000	..	..	—	4	Do. 4 p.c. Pref.	100—103	...	...
868,837	..	June 26	5	5	Do. 5 p.c. Deb.	118—123	...	121½—123
100,000	..	..	—	—	Do. 4 p.c. Deb.	102—105	...	...
647,740	..	Aug. 28	5	5	Southampt'n Ord. 5 p.c. max.	107—112	...	111—112
121,275	..	June 26	4	4	Do. 4 p.c. Deb.	99—104	...	...
350,000	..	Aug. 28	5½	5½	Swansea 5½ p.c. Red. Pref.	107—111	...	...
200,000	..	June 26	6½	6½	Do. 6½ p.c. Red. Deb.	103—108	...	...
1,076,490	..	Aug. 14	6½	6½	Tottenham and District Ord.	146—151	...	...
800,000	..	..	5½	5½	Do. 5½ p.c. Pref. ...	124—129	+3	126—126½
62,235	..	..	5	5	Do. 5 p.c. Pref. ...	112—117	...	114½
199,008	..	June 12	4	4	Do. 4 p.c. Deb. ...	98—103	...	...
85,701	..	Oct. 9	6	6	Tuscan, Ltd., 6 p.c. R d. Db.	90—100	...	...
347,759	..	Aug. 28	7	7	Uxbridge, &c., 5 p.ct. ...	144—149	...	147—148
88,330	..	..	5	5	Do. 5 p.c. Pref. ...	112—117	...	...
1,822,220	..	July 10	7	7	Wandsworth Consolidated	152—157	...	155—157
1,096,373	..	..	5	5	Do. 5 p.c. Pref.	117—122	...	121—122
1,317,964	..	June 26	5	5	Do. 5 p.c. Deb.	118—123	...	121½
158,400	..	Aug. 28	6A	5	Winchester W. & G. 5p.c. Con.	107—112	...	...

Quotations at:—*a.*—Bristol. *b.*—Liverpool. *c.*—Nottingham. *d.*—Newcastle. *e.*—Sheffield. *f*—The quotation is per £1 of stock *g.*—For quarter. *h.*—Paid £3, including 10s. on account of back dividends. *i* —The interest due 1/7/33 was paid on that date. * Ex. div. † Paid free of income-tax ‡ For year. Hongkong & China, Ltd.—paid on £10 shares.

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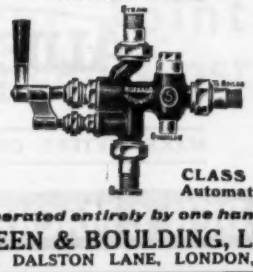

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(See advertisement Oct. 18, p. 176.)

APPOINTMENTS, &c., VACANT.

THE CITY OF STOKE-ON-TRENT.
(GAS DEPARTMENT.)

THE Gas Committee wish to Thank all Applicants for the Position of ASSISTANT GAS ENGINEER, as recently advertised, and to inform them that THE POSITION HAS NOW BEEN FILLED.

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Canvassing will be a disqualification, but candidates may send 20 copies of their application for the Members of the Committee.

FRANK KNOWLES,
Town Clerk.

Town Hall,
Stockport,
Oct. 17, 1933.

Continued on p. 360.

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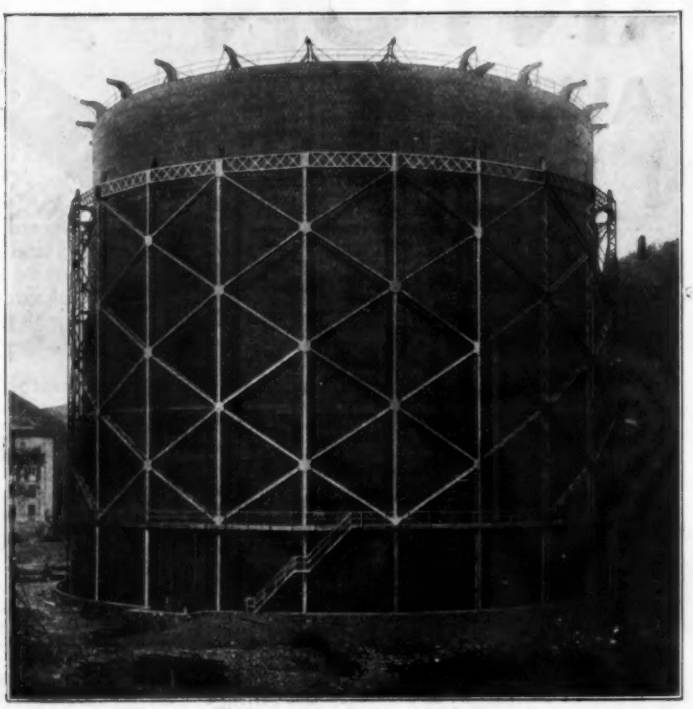

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(Continued.)

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Second Impression

The authors commenced this book with a belief and an aim. The belief is that a knowledge of the *principles* of gas utilization is a *sine qua non* of effective salesmanship in the Gas Industry; the aim was to deal simply and logically with these principles. Quite definitely the result bears no relation to a catalogue of gas-using appliances, but it is hoped that, with this book as a first step, the reader will in some measure be fitted to interpret the mechanism of gaseous combustion, to differentiate between good and bad apparatus and good and bad installation, and to appreciate underlying reasons for modification in design. It is hoped, too, that the book will be of immediate service to the younger members of the Gas Industry who, keen on their work, are embarking on the various examinations which assist in establishing a useful career in the Industry. It should be of special utility to those in the Second and Third Years (S2 and S3) of the Institution of Gas Engineers' Major Course in Gas Supply, and for those in the Third Year of the Minor Course in Gas Supply Practice.—*Extract from the Authors' preface.*

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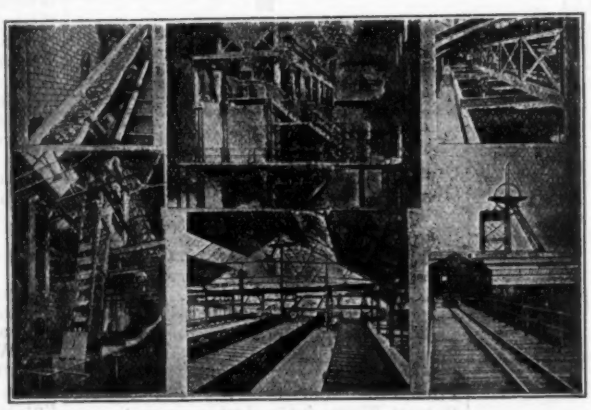

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